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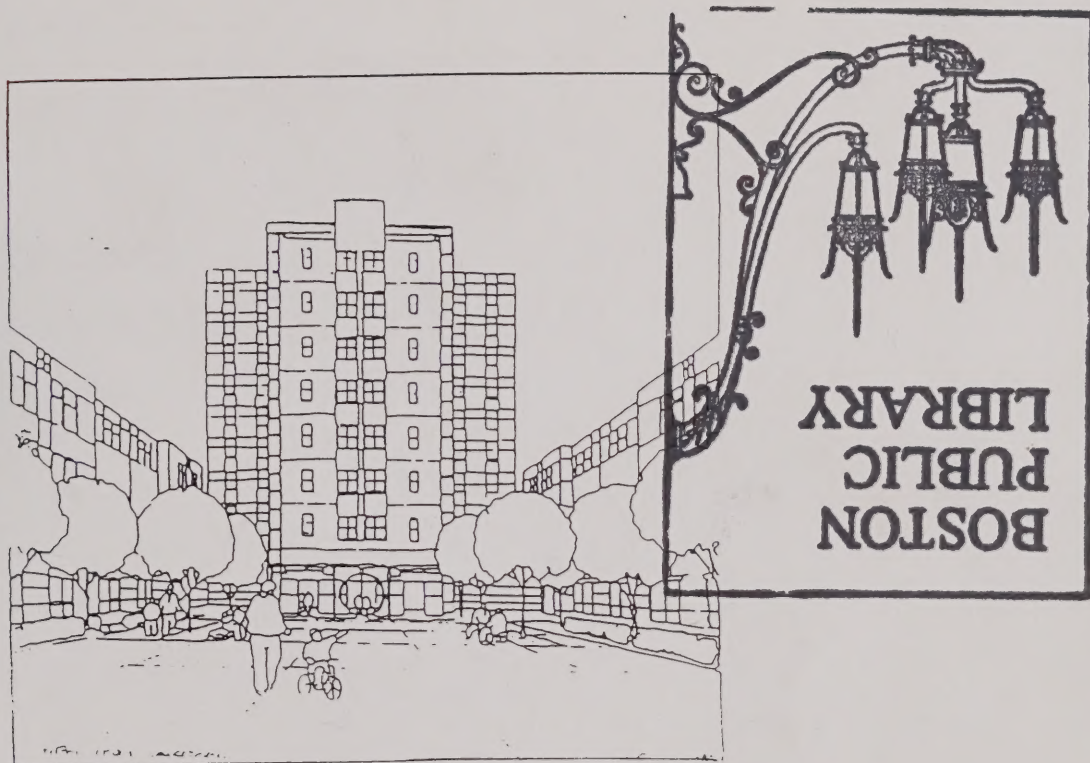


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A P P E N D I C E S



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OAK TERRACE PROJECT

888 Washington Street
Chinatown

AUGUST 26, 1992



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SCOPING DETERMINATION

**OAK TERRACE HOUSING PROJECT
(SOUTH COVE URBAN RENEWAL PARCEL R3B)
BOSTON REDEVELOPMENT AUTHORITY
March 25, 1992**

PROPOSED PROJECT: Oak Terrace Affordable Housing Development Project

PROJECT LOCATIONS: 888 Washington Street, (corner of Washington and Oak Streets), Boston, MA

APPLICANT: Asian Community Development Corporation (ACDC)

PNF SUBMISSION DATE: March 6, 1992

The BRA is issuing this Scoping Determination pursuant to Section 31-5 of the Boston Zoning Code (the "Code"). The applicant submitted a Project Notification Form ("PNF") on March 6, 1992. The Scoping Determination requests information required by the Boston Redevelopment Authority ("BRA") for its review of the Proposed Project in connection with the Development Review pursuant to Article 31 of the Code;

I. PREAMBLE

The BRA is reviewing the Proposed Project pursuant to multiple sections of the Code. The Proposed Project is being reviewed pursuant to Article 31 of the Code, Development Review Requirements, which sets out a comprehensive procedure for project review, and requires the BRA to review the design, transportation, environmental, and other impacts of proposed projects. Article 31 requires the submission of a satisfactory Final Project Impact Report ("FPIR") prior to the issuance of a building permit.

I. OAK TERRACE AFFORDABLE HOUSING DEVELOPMENT PROJECT (SOUTH COVE URBAN RENEWAL PARCEL R3B) PROJECT DESCRIPTION

The site of the Proposed Project is located at the confluence of community housing, services, and institutional uses in the Chinatown neighborhood. The parcel area measures about 38,411 square feet and currently contains a community garden, a vacant lot, a make-shift basketball court and play area, a dilapidated 6-story building, and a portion of a surface parking lot.

ACDC proposes to construct 88 rental housing units on Parcel R3B. Of the 88 units, 68% or 60 will be affordable to low and moderate income households. ACDC has designed a residential unit mix responsive to the great demand for affordable family sized units, including 74 two- and three- bedroom units, 9 four-bedroom units, and 15 one-bedroom units. Overall, 59% of the two bedroom units, 90% of the three bedroom units and 100% of the four bedroom units will be affordable to low and moderate income families.

The Proposed Project adopts the traditional design concept of the Chinese courtyard-houses. An elevated central courtyard will be constructed on top of a single-level, at-grade garage which will be fronted by a 13-storied housing tower on one side and surrounded by 4-storied duplexes on the other three sides. The residential tower fronting Washington Street will house 42 units, a majority of which are one- and two-bedroom flats. Another 46 family units will be housed in the four-storied duplexes with private entrances from Oak Street, Maple Place, Pine Street and the elevated central courtyard. A total of 47 parking spaces will be provided in the garage with its entrance/exit located on Washington Street and away from the main residential area.

As an alternative, the Proposed Project is considering providing offsite tenant parking on the surface lot located on the adjacent Parcel C which is bounded by Nassau, Ash and Oak Streets and owned by the BRA. Parcel C which accommodates a total of 62 parking spaces is currently leased by the BRA to the New England Medical Center. Under this alternative parking provision, the central courtyard will be constructed at grade and the basic design scheme described above will remain the same.

To help alleviate the acute shortage of open space amenities in Chinatown which has the highest density among the city's neighborhoods, a community plaza -Oak Street Plaza - will be created. The Plaza, which measures 35'-wide - including a 5'-wide sidewalk, will be designed, constructed and maintained by the ACDC. In addition to retaining part of the amenities currently available to the Chinatown residents, including a popular vegetable garden - the Oak Street Plaza will also add new amenities for public use and enjoyment with a permanent easement to the BRA.

OAK TERRACE AFFORDABLE HOUSING PROJECT SUMMARY

Total Lot Area	30,854	
Oak Street Public Plaza	5,485	
Gross Floor Area	99,866	109,622
- Residential	96,446	106,222
- Community	920	920
- Commercial	2,500	2,500

Floor Area Ratio (Gross Floor Area to Total Lot Area)	3.24
Total Development Cost	\$14,700,000
Ratio of Residential/Total	97%
Dwellings Per Acre	105
Building Foot Print	30,000
Central Courtyard	10,246

UNIT MIX

	1-BR	2-BR	3-BR	4-BR	Total
Size	598 NSF	789 & 815	1017-1095	1101-1026	
Low Income Assisted Unit	0	9	14	7	30
Low Income Credit Unit	4	11	13	2	30
Market-Rate Unit	11	14	3	0	28
Total Unit	15	34	30	9	88
Barrier Free	1	2	1	1	5

II. CHINATOWN ZONING AND COMMUNITY PLAN

The following comments are based on BRA review of the PNF, and do not include the comments of the Inspectional Services Department, which enforces the Code. Therefore, these cannot be relied upon in any application for a building permit or any request for zoning relief.

Pursuant to Article 43, the Proposed Project is located in the Residential Chinatown Subdistrict in the Chinatown District and is, therefore, subject to a maximum building height of eighty (80) feet and a maximum FAR of four (4). If the Proposed Project has been certified by the Boston Redevelopment Authority to be in compliance with the provisions of Article 31, Development Review Requirements, a maximum building height of one hundred (100) feet and a maximum FAR of six (6) are allowed.

The proposed FAR at 3.25 and the 37' building height of the walk-up duplexes which account for over 75 percent of the building footprint for the residential component are within the standard zoning regulations. As proposed, the 130' building height of the housing tower exceeds the enhanced height limit of 100' allowed under Article 43.

In accordance with Article 43 and the Chinatown Community Plan, the proposed project should reflect the land use goals established for the Residential Chinatown Subdistrict which are:

- o To continue to be the primary residential hub for mixed-income families, especially for new immigrants.
- o To encourage the creation of affordable housing and quality open space by increasing building height allowed under zoning.
- o To protect major neighborhood streets, open space, and activity modes from excessive shadow and traffic impacts.
- o To connect large scale, high-rise housing with modestly scaled townhouses in an amenable setting.
- o To provide for the continuing presence of small businesses, services, and home-based offices to serve residential interests.

The Proposed Project should further adhere to the general goals and objectives established for Open Space and Urban Design established in the Chinatown Community Plan including the following:

Open Space

- o To increase the accessibility and the quality of open space in the district.

- o To explore and to create alternative forms of open space activity areas.
- o To encourage versatility of design and flexibility in management.
- o To protect and enhance the pedestrian-oriented environment.
- o To expand and establish an open space network in the neighborhood.

Urban Design

- o To promote a unique neighborhood image that reflects the goals and objectives set forth by the community.
- o To improve the visibility and orientation between Chinatown, the Bay Village, and the South End.

Historic Preservation

- o To encourage architectural designs that reflect the cultural heritage of Chinatown
- o To strengthen the unique streetscape and ambience of the neighborhood.

III. DEVELOPMENT REVIEW REQUIREMENTS - ARTICLE 31

Article 31 of the Code institutes a process by which large-scale development projects will be reviewed by the BRA. As previously stated, the BRA is issuing this Scoping Determination pursuant to Section 31-5. The Draft Project Impact Report (DPIR) must conform to Article 31 and to this Scoping Determination.

SUBMISSION REQUIREMENTS

In addition to full-size scale drawings, 25 copies of a bound booklet containing all of the following submission materials reduced to size 8 1/2" x 11", except where otherwise specified, are required. In addition, an adequate number of copies must be available for community review.

I. GENERAL INFORMATION

1. Applicant Information

A. Development Team

1. Names

- a. Developer (including description of development entity)
- b. Attorney
- c. Project consultants

2. Business address and telephone number for each

3. Designated contact for each

4. Description of current or formerly-owned developments in Boston

B. Legal Information

1. Legal judgments or actions pending concerning the Proposed Project

2. History of tax arrears on property owned in Boston by development team

3. Evidence of site control over the project area, including current ownership and purchase options of all parcels in the Proposed Project, all restrictive covenants and contractual restrictions

affecting the Applicant's right or ability to accomplish the Proposed Project and the nature of the agreements for securing parcels not owned by the Applicant

4. Nature and extent of any and all public easements into, through, or surrounding the site
5. Nature and extent of requirements arising from the South Cove Urban Renewal Plan.

2. Financial Information

(See Appendix 1 for required financial information to be submitted to the BRA under separate cover from the DPIR.)

- A. Full disclosure of names and addresses of all financially involved participants
- B. Development Pro Forma
- C. Fifteen Year Operating Pro Forma

3. Project Area

- A. Description of metes and bounds or certified survey of project area

4. Employment

- A. Anticipated employment levels including the following:
 1. Estimated number of construction jobs
 2. Estimated number of permanent jobs

5. Regulatory Controls and Permits

- A. Existing zoning requirements, zoning computations, and any anticipated requests for zoning relief
- B. Anticipated permits required from other local, state, and federal entities, including Boston Conservation Commission Order of Conditions and

Department of Environmental Protection Chapter 91 License, with a proposed application schedule

- C. Any anticipated amendments to the South Cove Urban Renewal Plan

6. Community Groups

- A. Names and addresses of project area owners, displacees, abutters, and any community groups which, in the opinion of the Applicant, may be substantially interested in or affected by the Proposed Project
- B. A list of meetings proposed and held with interested parties including the Chinatown/South Cove Neighborhood Council and other interested/affected parties in the neighborhood.

7. Tax Revenues

- A. Increase in tax revenue payments, specifying existing and estimated annual property taxes

II. TRANSPORTATION COMPONENT

The Transportation Access Plan required pursuant to Section 31-6 must analyze the impact of the Proposed Project with respect to vehicular access and circulation, and proximity to other transportation systems. Pursuant to Section 23-1, a minimum of 44 off-street parking spaces will be provided in an on-site garage, at a ratio of 0.5 for 88 units of housing, which is located in the Chinatown Residential Subdistrict with a maximum FAR at 4, under the standard zoning regulations. Any further adjustment of the parking space provision must be considered with reference to the special characteristics in the parking needs of tenants in the area, the established use patterns, car ownership and other applicable factors.

A combined New England Medical Center (NEMC)/Chinatown Housing Transportation Study has been sponsored by the NEMC for the Institutional Transportation and Parking Management and Mitigation Plan pursuant to Section 43-18. This study also covered the Transportation Access Plan required for the community housing and development projects proposed for Parcel R3A, Parcel R3B, and Parcel C pursuant to Section 31-6.

A scope of the Transportation Study which includes underground garages located under Parcels R3A, R3B and C was approved and submitted by the NEMC in accordance with the Certificate of the Secretary of Environmental Affairs issued for the NEMC 1-C North and South Project Projects (See Appendix 2). A report of the combined study has been reviewed and accepted by the Boston Transportation Department.

Under the alternative provision of offsite surface parking on Parcel C, 44 of the current institutional parking spaces will be substituted for tenant spaces with no changes in the existing entrance and exit points.

III. ENVIRONMENTAL PROTECTION COMPONENT

1. Shadow

A shadow analysis is required for existing and build conditions for the hours of 9:00 a.m., 12:00 noon, and 3:00 p.m. for the vernal equinox, summer solstice, autumnal equinox, and winter solstice. It should be noted that due to time differences (daylight savings vs. standard), the autumnal equinox shadows would not be the same as the vernal equinox shadows and therefore separate shadow studies are required for the vernal and autumnal equinoxes.

The shadow impact analysis must include net new shadow as well as existing shadow and must clearly show the incremental impact of the proposed buildings. Shadows of surrounding buildings also shall be included, as appropriate, to indicate clearly the net shadow impact of the project.

Particular attention must be given to existing or proposed public open spaces and major pedestrian areas, including, but not limited to, the sidewalks surrounding the project site and the proposed project open spaces and pedestrian ways (particularly the central courtyard and the Oak Street public open space.)

2. Daylight

A minimal daylight study is required, taking at least one viewpoint for study on Washington Street which fronts the 13-story component of the project, and comparing the result with values for the adjacent 10- and 18- story projects referenced in the PNF. Alternatively, the value of an "as-of-right" zoning envelope may be used as guidelines datum. The BRADA program should be used.

3. Air Quality



The DPIR must describe the existing air quality in the project vicinity and shall evaluate ambient levels to determine conformance with the National Ambient Air Quality Standards of the U.S. Environmental Protection Agency. Existing data from the Massachusetts DEP may be used for this analysis, and no additional monitoring will be required.

4. Solid and Hazardous Wastes

The presence of any contaminated soil or groundwater shall be identified, and measures that will be employed to ensure their safe removal and disposal shall be described. A copy of site and groundwater investigation report prepared in compliance with M.G.L. Chapter 21E must be included in the DPIR.

The generation of solid wastes (construction period and operation of the project) and plans for removal and disposal must be described.

5. Noise

← An evaluation of ambient noise levels is required to determine conformance with the Design Noise Levels established by the U.S. Department of Housing and Urban Development. Particular attention shall be given to traffic noise generated from the Massachusetts Turnpike. Should excessive ambient noise levels exist, mitigation measures to reduce these levels to acceptable levels must be described.

Anticipated long-term noise increases from project-generated traffic and from the project's building mechanical equipment must be evaluated.

6. Geotechnical Impact

An analysis of existing sub-soil and groundwater conditions, potential for ground movement and settlement during excavation, and potential impact on adjacent buildings and utility lines is required. This analysis must also include a description of the foundation construction methodology, the amount and method of excavation, and measures to prevent any adverse effects on adjacent buildings and utility lines.

If excavation and foundation construction will extend below the existing water table, an analysis is required of the impact of foundation construction on the maintenance of groundwater levels will not be lowered during or after construction shall be described.

8. Construction Impacts

A construction impact analysis shall include a description and evaluation of the following:

- (1) potential dust and pollutant emissions and mitigation measures to control these emissions.

- (2) potential noise impact and mitigation measures to minimize increase in noise levels.
- (3) location of construction staging areas and construction worker parking.
- (4) construction schedule, including hours of construction activity.
- (5) access routes for construction trucks and anticipated volume of construction truck traffic.
- (6) method of demolition of the existing building on site, control of emissions, the removal and disposal of any asbestos, and disposal of the demolition waste, including identification of the disposal site.
- (7) measures to protect the public safety, particularly of residents and children attending the adjacent public school.

9. Rodent Control

An analysis of the impact of project construction on rodent populations and a description of the proposed rodent control program, including frequency of application, and compliance with applicable City and State regulatory requirements shall be required. When and where appropriate, the proposed program should coordinate with the control measures implemented by the Central Artery Reconstruction Project.

IV. URBAN DESIGN COMPONENT

The DPIR must address the Urban Design Standards set forth in Section 8 of Article 31 of the Code as well as the urban design objectives of the Chinatown Zoning. The following list of variables must be addressed in each of the design studies that are recommended in consultation with the BRA and studied in detail in the DPIR:

- o Facade design, and building massing along Washington Street frontage and Oak Street edge that reinforce community identity and public orientation.
- o Provision for design treatments, materials and plant species and other measures that articulate the cultural heritage of the community.
- o Refinement of building massing and design treatments of the facades to augment the physical transitional and connection along/across the new public way to be created between the project site and Parcel R3A2.

- o Refinement of open space design to reinforce visual and physical continuity along the Oak Street community corridor extending from Tai-Tung Village to Mass Pike Tower.
- o Provision for building massing and tree planting that eliminate excess shadows while providing comfortable outdoor settings for active and passive recreation and uses by school-age children and the elderly in particular.
- o Provision for landscaping, design treatments and materials that absorb noise and enhance privacy for residences at ground level.
- o Provision for design treatments, furnishings, plantings and security measures for the community plaza that facilitate the transition from a passive public green space to entrance for private residencies.
- o Provision for management and design measures for the community plaza and the central courtyard that facilitate regular maintenance and increase flexibility in seasonal uses.
- o Creation of a contiguous public space network with minimum pedestrian/vehicular conflict connecting the community plaza proposed for the project site, the cultural center for Parcel R3A, and the community center planned for Parcel C.

In order to determine that the Proposed Project (a) is architecturally compatible with surrounding structures; (b) exhibits an architectural concept that enhances the urban design features of the subdistrict in which it is located; (c) augments the quality of the pedestrian environment; and (d) is consistent with the established design guidelines that exist for the area, the following design materials must be submitted:

- A. Written description of program elements and space allocation for each element
- B. Plan for the surrounding area and district and section at an appropriate scale (1" = 40' or larger) showing relationships of the Proposed Project to the surrounding area's and district's:
 - o Massing
 - o Building height
 - o Scaling elements
 - o Public space/open space
 - o Major topographic features

- o Pedestrian and vehicular circulation
- o Land use
- C. Black and white 8" x 10" photographs of the site and neighborhood
- D. Sketches, diagrams, and photographs where relevant, to clarify design issues and massing options
- E. Eye-level perspective(s) (reproducible line drawings) showing the proposal in the context of the surrounding area
- F. Aerial views of the project
- G. Site sections at 1" = 20' or larger showing relationships to adjacent buildings and spaces
- H. Site plan at an appropriate scale (1" = 20') or larger showing:
 - o General relationships of proposed and existing adjacent buildings and open space
 - o Open spaces defined by buildings on adjacent parcels and across streets
 - o General location of pedestrian ways, driveways, parking, service areas, streets, and major landscape features
 - o Pedestrian, handicapped, vehicular and service access and flow through the parcel and to adjacent areas
 - o Survey information, such as existing elevations, benchmarks, and utilities
 - o Construction limits
- I. Proposed schedule for development of project
- J. Drawings at an appropriate scale (1" = 8' or larger) describing architectural massing, facade design and proposed materials including:
 - o Site improvement plans
 - o Elevations in the context of the surrounding area
 - o Sections showing organization of functions and spaces

- o Preliminary building plans showing ground floor and typical upper floor(s)

K. Proposed schedule for submittal of design development materials

V. HISTORIC RESOURCES COMPONENT

The DPIR must include an assessment of the potential adverse effect on the architectural, archaeological, or cultural resources of any site, building, structure of object listed in the State Register of Historic Places.

VI. INFRASTRUCTURE SYSTEMS COMPONENT

The Infrastructure System Component of the DPIR must address anticipated volume requirements and generation for water, sewerage, storm drainage, electricity/energy, telephone, gas, steam, cable/computer or other special systems. It must include an evaluation of the Proposed Project's impact on the capacity and adequacy of these systems, and whether a need is reasonably attributable to the Proposed Project for upgrading of existing systems.

The analysis must include future projects which may affect the loading of utility systems including Parcel R3-A Housing Development, Parcel C Community Service Center, and NEMC 1c project.

Any system upgrading or connection, requiring a significant public or utility investment, or creating a significant disruption in vehicular or pedestrian circulation, or affecting any public or neighborhood park or streetscape improvements, comprises an impact which must be mitigated. The project proponents must research and demonstrate anticipated impacts in this regard, including specific mitigation measures, and must include all other proposed projects in the vicinity which have submitted a PNF as background for analysis.

Thorough consultation with the planners and engineers of the utilities will be required, and should be referenced in the Infrastructure Component report.

Particular consideration should be given to the upgrading or reconfiguration of existing connections, including the potential upgrading of any combined sewerage systems to separate storm drain and sanitary sewer systems. Because the proposed project includes realignment of existing streets, the impact study analysis should be specific about planned utility line abandonments or relocations and the phasing of any such alterations in conjunction or relationship to the project's planned construction schedule. Measures taken to insure continuity of service to other utility users should be referenced.

VII. AGREEMENTS

The following must be provided in form and content satisfactory to the appropriate signatory public agencies before the Proposed Project can receive final approval. They are not required for the DPIR.

1. If applicable, Cooperation Agreement, pursuant to Section 31-14 of the Code, to provide for monitoring of continued compliance with the Final Project Impact Report, including, but not limited to, a Construction Management Plan Agreement, the Open Space Maintenance and Management Plan Agreement, and the Parcel C Lease Agreement for offsite parking.
2. Any applicable agreements relating to Urban Renewal requirements or ground leases, and the sale and conveyance of Parcel R3B.
3. Boston Residents Construction Employment Plan, pursuant to Chapter 12 of the Ordinances of 1986 of the City of Boston, as amended by Chapter 17 of said Ordinances, and Executive Order Extending Boston Residents Job Policy, signed by the Mayor on July 12, 1985.

APPENDICES

APPENDIX 1

FINANCIAL INFORMATION

REQUIRED FINANCIAL INFORMATION -- OAK TERRACE PROJECT

DEVELOPMENT PROFORMA Includes all the information normally found in a development proforma. This includes, but is not limited to:

Land acquisition costs, per land square foot and total, by parcel. Include distinctions between attributed value and actual out-of-pocket costs, if any. Also include any imputed or actual carrying costs.

Attribution of acquisition expense over project components. (Per FAR square foot residential, hotel, office, retail, parking, etc.)

All hard costs on a per-unit and total basis (desegregated into base building, tenant improvement work, rehabilitation work, residential finishes, garage cost, site work, furniture, fixtures and equipment, etc.)

All soft costs on a per-unit and total basis (desegregated into individual line items such as architectural, engineering, legal, accounting, total development management costs -- including staff, office expense, etc. -- and developer's fees and any other professional fees, insurance, permits, real estate tax during construction, etc.)

All contingencies on a per-unit and total basis (specify whether contingency is on hard cost, soft cost, or total cost).

All assumptions regarding financing terms on acquisition, pre-development, and construction loans (including financing fees, interest rates, terms, drawdown assumptions, terms, participation, amortization).

Any other project-related expenses not within any of the above categories.

Calculation of total development cost by component, including total and per unit breakdown.

Sources of debt and equity for total project costs. Appropriate return measures (return on equity, return on total development cost, internal rate of return; specify method of calculation and hurdle rates).

15-YEAR OPERATING PROFORMA includes all the information normally found in an operating proforma, on a yearly basis. This includes, but is not limited to:

Schedule of all rents whether base or percentage rents, on a per square foot and total basis.

Breakdown of anticipated operating expenses, including real estate taxes, with a per square foot analysis and a clear explanation of division of expenses between owner and tenant.

All other expense and vacancy assumptions set forth to calculate cash available for debt service.

Calculation of debt service, before tax cash flow, debt coverage ratios.

APPENDIX 2

TRANSPORTATION ACCESS PLAN REQUIREMENTS

**NEW ENGLAND MEDICAL CENTER/CHINATOWN HOUSING
TRANSPORTATION STUDY
REVISED SCOPE OF WORK
NOVEMBER 14, 1989**

The goal of the proposed study will be to fulfill MEPA requirements for a transportation impact analysis for the NEMC Phase 1-C project, and BRA requirements for a comprehensive transportation study of the NEMC master plan. The overall scope will be to analyze existing and future base year transportation conditions within the study area, to assess the traffic, pedestrian, transit and parking supply/demand impacts of the proposed NEMC Phase 1C North and South projects and for developments proposed independently for Parcels A, B and C, to identify problems and to recommend design revisions and other mitigating measures to improve any identified conditions. This scope has been designed to reflect issues raised in meetings and correspondence by the following agencies and groups:

- Boston Redevelopment Authority (BRA);
- Boston Transportation Department (BTD);
- Chinese Economic Development Council (CEDC); and
- Asian Community Development Corporation (ACDC).

Many of the issues raised by BTD in its suggested scope have been covered by NEMC in a 1986 Parking Needs and Site Evaluation Study, conducted by Vanasse/Hangen. The proposal here is not to repeat the extensive survey work conducted for this study, but to use this information as a base, updated where necessary to reflect current conditions -- as in the case of taking new traffic counts. Such update efforts will be noted in the scope below.

The study will involve the following tasks:

Task 1: Existing Conditions Analysis

In this task, the existing conditions information from the 1986 study and other sources will be updated. In this process, the following steps will be undertaken:

- 1) Hospital Profile. A detailed profile on existing employment and activity levels at NEMC will be developed, based on the 1986 study and other more current information from the medical center. NEMC will provide an accurate estimate of the actual number and type of employees, physicians, patients and visitors at the medical center during the course of a typical day, and detailed information on current employment, patient and visitation levels as well as recent historical information as appropriate.

- 1) Traffic. Traffic analyses will be undertaken for intersections shown in Figure 1. First, new (1989) AM and PM peak period traffic counts will be completed for the thirteen intersections included in the original 1986 study area. In addition, to address the impacts of the proposed Herald Street Garage expansion, we will add several intersections to the study area, namely:

- Herald Street/Albany Street and Broadway Bridge;
- Herald Street/Tremont Street/Arlington Street;
- East Berkeley Street/Shawmut Avenue;
- East Berkeley Street/Tremont Street; and
- East Berkeley Street/Washington Street.

In addition, at the review meeting with BRA and BTM, it was suggested that two other intersections to the north of the study area be included, namely:

- Surface Artery/Kneeland Street/Southeast Expressway Ramps; and
- Kneeland Street/Hudson Street.

For consistency's sake, we recommend that new counts be done at any study area intersections for which 1989 counts are not available from BTM or other sources. To document the impacts of moving the NEMC ambulance entrance from Harrison to Washington, classification counts to document the numbers of ambulances will be taken at the Washington Street and Harrison Avenue intersections adjacent to the IC site. Loading activity levels will be described as well.

Once the data are collected, analysis of existing traffic levels of service will be conducted for the AM and PM peak periods, and the findings will be summarized. To meet the MEPA guidelines for traffic impact analysis, we will use the operational level Highway Capacity Manual method of intersection capacity analysis ("CINCH" computer model) for the calculations.

- 2) Parking. Updates will be conducted of parking rates in the study area, which have risen substantially since 1986. Occupancy checks of the six facilities surveyed in 1986 will be conducted at peak hour - 1:00 PM -- to identify any changes in occupancy. The detailed information about parking patterns, user

mix, etc. will be obtained from the 1986 report, checked against records of employee stickers issued, etc. which can provide evidence of any changes in overall parking facility use policies. Based on the above data, and on the transit use data established in the step below, existing parking supply/demand for NEMC will be documented.

3) Transit. A major change since 1986 has been the opening of the new Orange Line, which has brought a new station directly to NEMC's front door. To see if this improvement, combined with increased parking rates, has increased transit use, we recommend a brief employee survey. The 1986 study included a thorough survey of employees, patients. Since employees are the main source of peak hour traffic, we recommend that the employee survey be repeated, in a briefer version, to determine the effects of the new station on mode choice. In addition, we will look at records of MBTA pass sales, etc. (taking into account the fact that MBTA does not allow commuter rail passes beyond Zone 4 to be sold at the hospital). Transit use will, of course, be a key determinant of future parking demand and traffic impacts. Patients and visitors are a much smaller component of peak hour trips, and are also less likely to change mode as a result of the new Orange Line; thus we do not propose to repeat the patient/visitor survey.

A) Pedestrians. The primary pedestrian issues relate to crossings of Washington Street by employees and visitors, and to the safety of schoolchildren at the Quincy School under various parking access scenarios. To document pedestrian issues, we propose to conduct peak period (AM, PM, and lunchtime) pedestrian counts at the following locations:

Intersection Pedestrian Movements:

- Washington/Oak Street;
- Washington/Marginal Road
- Harrison/Marginal Road
- Harrison/Oak Street.

Midblock Pedestrian Movements:

- both sides of Washington north of Oak Street (at NEMC Phase 1C North and South site);
- both sides of Oak Street between Washington and Harrison;

- both sides of Washington between Oak Street and Marginal Road at the Quincy School site (also to include school opening and closing times) ; and
- both sides of Marginal Road between Washington and Harrison.

Task 2 -- Development of Base Year (2000) Conditions

In this task, the traffic, transit, and pedestrian trips to be generated by the many projects planned to occur between the present and the design year will be documented. Several factors must be considered in formulating such an estimate, as discussed below.

Determination of Design (Base) Year. Because the NEMC Master Plan covers an approximate ten year planning horizon, the year 2000 has been designated as the design year. This is consistent with MEPA guidelines, which suggest a five year time frame as a minimum.

Background Development to be Analyzed. The Year 2000 traffic estimates must be derived from specific estimates for those projects near the study area which will contribute traffic through the area, and those local projects which will contribute new traffic to specific destinations within the study area. Luckily, nineteen projects on the books from 1989-1994 have been summarized in conjunction with the Boston Crossing project. These include "megaprojects" such as Boston Crossing itself and Commonwealth Center, which will add millions of square feet of floor space to the midtown/downtown area. We propose to use these numbers as a base, extended into the study area (primarily in the Kneeland Street corridor) through standard trip distribution techniques. Then, additional specific projects scheduled for completion from 1995-2000, such as Tufts University plans and the Boston Centennial Partners development on Tremont Street will be identified through discussions with BRA. It may be that only a general indication of likely sites is possible at this time. In this event, the 1995 base will be factored upward based on an estimate of areawide square feet to be added, by land use if possible.

Design Year Roadway Assumptions. In this task, assumptions will also have to be made regarding the future roadway network, and specifically the proposed Central Artery Third Harbor Tunnel project. At the present time, the City and State disagree about the treatment of the South Bay interchange (the point at which the Turnpike, the new tunnel, and the Southeast Expressway will intersect). A major point of contention is the MDPW's proposal to use Marginal Road as the major conduit for westbound traffic leaving the expressway system. The City proposes new Turnpike ramps -- a westbound off-ramp at Berkeley Street and an eastbound on-ramp at Arlington Street -- as an alternative. We propose that the following options be analyzed:

- no build option (existing Central Artery and expressway ramp arrangement):

- MDPW proposed scheme (emphasis on Herald St. and Marginal Rd. frontage roads); and
- City of Boston proposed scheme (new Turnpike westbound off-ramp at Arlington Street and eastbound on-ramp at Clarendon Street).

According to BTB, studies and negotiations are ongoing regarding the City's proposed Turnpike ramp scheme, with a possible resolution occurring within the time during which the DEIR will be preparation. In this regard, the ramp access options will be eliminated from consideration or changed to reflect solutions agreed upon by the MDPW and the City of Boston.

Following this step, traffic, pedestrian, and transit impacts of the future year development will be estimated for the study area and summarized.

Task 3 -- Analysis of Project Impacts

Here, the impacts of proposed NEMC Master Plan developments and the developments on Parcels A, B, and C will be estimated based on the same procedure of trip generation, trip distribution and impact analysis. The 1986 Medical Center study contains good information about trip distribution which can be used, along with the new employee survey results, to analyze the increased trips resulting from the projected new space. Transit, parking, and pedestrian analyses will also be conducted. Projects to be analyzed individually are shown in Figure 2. They include:

New England Medical Center Master Plan elements:

- 1-C Project Phase 1 -- 1-C North and South (completion 1994-1995). The 1-C project includes:
 - 1-C North -- 171,025 sf
 - 1-C South -- 80,944 sf
 - (1-C North and South together include 196 beds)
 - As part of Phase 1, emergency entrance will be relocated from Harrison Avenue to Washington Street
- Expansion of Herald Street Garage from 400 spaces to 1,000 employee spaces (1992)
- 1-C Phase 2 -- 92,000 sf (schedule to be determined)
- 1-C Phase 3 -- 125,000 sf (schedule to be determined)
- Research Building -- 250,000 sf (schedule to be determined)

Parcel A Development -- CEDC

- Mei Wah Village -- 69 condominiums, 72 rental units, 160 parking spaces

Parcel B Development -- ACDC

- 120 rental units, 90 parking spaces

Parcel C Development -- BRA

- 90,000 square foot recreation center, undetermined number of parking spaces

Of particular concern are the impacts of the proposed replacement for the Herald Street garage and the alternative parking arrangements for Parcels A, B, and C. BRA, BTB and the housing developers have proposed several options to be considered within the DEIR. The NEMC and housing development architects and engineers have come to the conclusion that options involving a garage extending under Oak Street are infeasible. The DEIR will thus look at the following two alternatives:

- Option A: two underground garages -- one under Parcels A and B and a second under Parcel C. NEMC parking needs to be met by Herald Street garage expansion.
- Option B: three underground garages -- one under Parcel A, one under Parcel B, one under Parcel C. NEMC parking needs to be met by Herald Street Garage expansion.

Entrance and exit points to be analyzed will be agreed upon with the City and with the various project architects. The locations north of the Turnpike will include various combinations of Marginal Road, Washington Street, and Oak Street driveways. In addition, several options for the Herald Street Garage will be looked at. Due to the number of possible options, it is proposed to look at the garage access options on a subarea basis, limited to impacts on the blocks and intersections adjacent to the sites. There will be little difference in total traffic impact for the various options.

The transportation study will also address various traffic, transit, parking, and pedestrian issues raised by the agencies and groups, including:

- opportunities for shared parking between Parcels A, B, C and NEMC;

- traffic or pedestrian safety impacts of the internal traffic flow in the Parcel A and B housing components as a result of the extension of Maple Place as a public way;
- transit riders generated by corridor related to line capacity;
- supply/demand relationships for delivery and service vehicle parking and loading space (discussed in terms of the medical center's ability to schedule truck activities outside peak traffic periods);
- traffic/pedestrian access issues related to Nassau Street realignment between Phase IC South site and Parcel C;
- construction period issues;
- impacts of street circulation alternatives proposed by BTB and others, including:
 - direction change on Oak Street between Tyler and Harrison to reduce commuter bypass traffic;
 - others proposed by BTB, BRA, others;
- MBTA replacement service issues;
- concerns about traffic and pedestrian safety at Quincy School.

Task 4 -- Mitigating Measures

In this task, problem areas identified in the tasks above will be analyzed further to see if impacts can be reduced through both travel demand management measures such as signalization, signal timing, signing, on-street parking restrictions, or intersection design, and "demand side" measures such as parking pricing and transit and ridesharing incentives. Some of these measures have already been outlined in the 1986 study.

Since the impacts of the background development and the Central Artery/Third Harbor Tunnel project are so large compared to the impacts of the NEMC Phase 1-C and housing projects, even in combination, much of the mitigation will be carried out in conjunction with other projects. Our effort in this task will be to isolate for action only those problem areas and measures which are clearly related to the various proposals under consideration.

APPENDIX B: FINANCIAL INFORMATION

ASIAN COMMUNITY DEVELOPMENT CORPORATION
OAK TERRACE - MHFA MORTGAGE FINANCING

PROGRAM SUMMARY

Unit Type	S.8 PBA	S.8 non-PBA	low @50%	Market	Total	Net Rentable Sq. Ft.	Total Net Rentable Sq. Ft.
1-BR	0	0	4	10	14	600	8,400
2-BR	9	2	12	9	32	810	25,920
3-BR	11	2	12	8	33	1,150	37,950
4-BR	5	1	2	1	9	1,350	12,150
TOTAL	25	5	30	28	88		84,420
%	28%	6%	34%	32%	100%	NSF/GSF	79.53%
Residential						NSF	GSF
Commercial - Bank ATM						84,420	106,148
Commercial						500	629
						2,275	2,861
						TOTAL GSF	109,637

PARKING GARAGE - OFFSITE

of Spaces

44 Spaces

1992 MAXIMUM TAX CREDIT & SECTION 8 RENTS

	0-BR	1-BR	2-BR	3-BR	4-BR
HOUSEHOLD SIZE	1.0	1.5	3.0	4.5	6.0

	FEB 1991 INCOME LIMITS					
HOUSEHOLD SI	1	2	3	4	5	6
Median	35,500	40,600	45,600	50,700	54,800	58,800
60% of Media	21,300	24,360	27,360	30,420	32,880	35,280
50% of Media	17,750	20,300	22,800	25,350	27,400	29,400

	ALLOWABLE RENTS				
	0-BR	1-BR	2-BR	3-BR	4-BR
60% LIHTC Rents	\$533	\$571	\$684	\$791	\$882
50% LIHTC Rents	\$444	\$476	\$570	\$659	\$735
1992 50% LIHTC Rents	\$460	\$493	\$589	\$684	\$762
FY 1992 FMR	\$631	\$767	\$902	\$1,129	\$1,264
FY 1993 FMR (PROPOSED)		\$668	\$786	\$983	\$1,100
Section 8 PBA Contract Rents		783	923	1,130	1,248

NOTE: UTILITY ALLOWANCE - BHA Utility Allowance Chart 1/1/92

Utility Allowance Estimate based on Boston Housing Authority Section 8 / Chapter 707 Utility Allowance Chart. Tenants pay own electricity and cooking fuel. Heat and hot water included in rent.

	UTILITY ALLOWANCE			
	1-BR	2-BR	3-BR	4-BR
Cooking Fuel	7	8	10	12
Electricity	26	30	35	41
	33	38	45	53

IX. DEVELOPMENT PROFORMA

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ACQUISITION COSTS

1. Land	1,500,000	
2. Buildings	0	

Total Acquisition Costs		1,500,000

HARD COSTS

3. Construction Costs @	\$79.02 /sf	8,663,000
4. Construction Contingency	2.5% of line 3	216,600

Total Hard Costs		8,879,600

SOFT COSTS

5. Architectural & Engineerin	6.8% of H.C.	602,800
6. Legal		125,000
7. Financing Fees		
Capitalized Interest	0.00% of loan	0
LIHTC Fees	4.00% of LIHTC	36,700
Application & Site Appro	0.80% of P Loan	51,000
Mortgage Origination Fee	2.00% of P Loan	127,500
Credit Enhancement Fee	0.00% of P Loan	0
8. Accounting & Cost Certification		24,000
9. Development Consultant		225,000
10. Real Estate Taxes		31,000
11. Syndication Fees & Costs		0
12. Insurance		70,000
13. Const. Loan Int	9.00% 0.50% 13	328,100
14. Bonding	1.0% of line 3	86,600
15. Permits	1.0% of line 3	86,600
16. Marketing & Rent-Up		120,000
17. Other: Development Management/Overhead		225,000
Clerk of the Works		75,000
Appraisal Fee		5,000
Seed Money Interest		5,000
Title & Recording		17,000
Hazardous Waste Remediation		40,000
Bridge Loan Interest		0
Net worth reserve		0
Investor service and audit reserve		0
Project Reserves		0
Soft Cost Contingency	3.51%	80,000
18. Developer's Overhead	0.0% of TDC	0
19. Developer's Fee	0.0% of TDC	0

Total Soft Costs		2,361,300

TOTAL DEVELOPMENT COSTS

12,740,900

X. SUMMARY OF SOURCES AND USES

USES

Total Development Costs 12,740,900

Permanent

SOURCES

1. MHFA Mortgage (AFL-CIO Housing Investment Trust)	6,376,200
2. CDAG	500,000
3. BRA/SPONSOR Acquisition Loan	1,500,000
4. BRA PWED Grant	0
5. City of Boston Capital Planning Grant for Demolition	0
6. Neighborhood Housing Trust (Linkage)	150,000
7. Syndication Equity	4,214,700
8. Unpaid Developer's Fee	0

Total Sources 12,740,900

Difference, between Sources & Uses 0

TOTAL CITY OF BOSTON/BRA CONTRIBUTION

Operating Subsidy Escrow

Neighborhood Housing Trust (Linkage) 1,100,000

Subtotal Operating Subsidy Escrow 1,100,000

Upfront Capital Contribution for Construction

BRA PWED Grant 0

Neighborhood Housing Trust (Linkage) 150,000

Subtotal Capital Contribution for Construction 150,000

TOTAL CITY OF BOSTON/BRA CONTRIBUTION 1,250,000

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First Year Operating Subsidy 258,526

Minimum Escrow Balance 10,557

Operating Subsidy Thru Year 13

SYNDICATION PROCEEDS

Gross Proceeds 6,085,000

Cost of Placement 418,400

Net Worth Requirement 608,500

Bridge Loan Interest 333,332

Investor Services / Audit Funds 113,360

Section 8 PBA Reserve 106,077

Project Reserves 90,631

Net Syndication Equity 4,414,700

Project Costs 4,214,700

Operating Escrow 200,000

Annual Low Income Housing Tax Credits Available 1,178,994

Annual Low Income Housing Tax Credits Utilized 917,903

Net Proceeds per \$1 of LIHTC 48.10%

XI. PROPOSED RENT SCHEDULE

		1992	1992	1992	1994	1994
	# of	Gross	Utility	Net	Net	Total
	Units	Rents	Allowance	Rents	Rents	Monthly
						Rents
<u>SECTION 8 PBA UNITS</u>						
1-BR	0	783	33	750	750	0
2-BR	9	923	38	885	885	7,965
3-BR	11	1,130	45	1,085	1,085	11,935
4-BR	5	1,248	53	1,195	1,195	5,975
Subtotal s.	25					25,875
<u>SECTION 8 NON-PBA UNITS</u>						
1-BR	0	668	33	635	635	0
2-BR	2	786	38	748	748	1,496
3-BR	2	983	45	938	938	1,876
4-BR	1	1,100	53	1,047	1,047	1,047
Subtotal s.	5					4,419
<u>LOW INCOME CREDIT UNITS @ 50% of MEDIAN INCOME (MODERATE INCOME UNITS)</u>						
1-BR	4	493	33	460	495	1,980
2-BR	12	589	38	551	593	7,116
3-BR	12	684	45	639	687	8,244
4-BR	2	762	53	709	762	1,524
Subtotal Low	30					18,864
<u>MARKET UNITS</u>						
1-BR	10	750	0	750	750	7,500
2-BR	9	975	0	975	975	8,775
3-BR	8	1,175	0	1,175	1,175	9,400
4-BR	1	1,375	0	1,375	1,375	1,375
Subtotal Mar	28					27,050
<u>TOTAL</u>						
1-BR	14					9,480
2-BR	32					25,352
3-BR	33					31,455
4-BR	9					9,921
	88					76,208
<u>ANNUAL RENTAL INCOME</u>						914,496

XII. PROJECTED FIRST YEAR OPERATING PROFORMA

OTHER ANNUAL INCOME

i. LAUNDRY INCOME	\$6.00 / month x	46 1&2BR Units	3,312
less vacancy @	5.0%		(166)
ii. COMMERCIAL INCOM	\$8.50 / SF x	2,275 SF	19,338
ATM INCOME	\$30.00 / SF x	500 SF	15,000
less vacancy @	10.0%		(3,434)
iii. SPONSOR OPERATING SUBSIDY: LINKAGE	6,376,200	10,557	258,526

Other Annual Income	292,576
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GROSS ANNUAL INCOME	1,207,072
Less: Vacancy Allowance - Market Units @	5% (16,230)
- Low/Mod Income	3% (17,697)

1. EFFECTIVE GROSS INCOME	1,173,145
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2. EXPENSES

A. Annual Operating Expenses	per unit	
1. Administrative	717	63,115
2. Maintenance	1,273	112,005
3. Heat (Gas)	470	41,360
4. Electricity	300	26,400
5. Water & Sewer	380	33,440
6. Real Estate Taxes	600	52,800
7. Insurance	275	24,200
8. Marketing	57	5,029
9. Security	331	29,120
10. Other - EOCD Admin Fee	59	5,162

TOTAL OPERATING EXPENSE	4,462	392,630
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B. Replacement Reserve	275	24,200
C. Management Fee	500	44,028

3. NET OPERATING INCOME	712,286
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4. ANNUAL DEBT SERVICE	647,533
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	Rate	Fees	Term	Constant	Mortgage
MHFA (AFL-C	9.000%	0.50%	30	10.1555%	6,376,200

5. CASH FLOW (DEFICIT) FROM OPERATIONS	64,753
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Freezing assumptions	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Low Income 5.4 PBI Rents	4.0%	4.0%	0.0%	0.0%	2.5%	2.5%	2.5%	2.5%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Low Income 5.4 non-PBI Rents	0.0%	0.0%	0.0%	0.0%	3.0%	3.0%	3.0%	3.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Low Income Credit Rents	0.0%	0.0%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Market Rents	0.0%	0.0%	0.0%	0.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Expenses (except as indicated)	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

NET RENT INCOME	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Low Income 5.4 PBI Rents	310,500	318,263	326,219	334,375	342,334	356,443	370,701	385,529	400,950	416,948	433,668	451,014	469,055	487,817	507,310	527,546	548,536	569,276
Low Income 5.4 non-PBI Rents	53,028	54,619	56,357	57,945	59,480	62,071	64,554	67,136	69,821	72,614	75,519	78,539	81,681	84,946	88,336	91,851	95,491	99,256
Low Income Credit Rents (Ind)	226,368	234,744	243,429	252,436	261,776	272,287	283,137	294,463	306,261	318,491	331,220	344,460	358,159	372,389	387,143	392,444	398,244	404,544
Market Rents	334,600	340,430	357,872	375,765	394,553	414,281	434,995	456,745	479,582	503,561	528,739	555,176	582,935	612,082	642,686	674,786	708,436	743,686

GROSS POTENTIAL NET RENT INCOME	914,495	948,455	983,777	1,020,521	1,059,147	1,105,042	1,153,387	1,203,872	1,256,595	1,311,654	1,369,356	1,429,210	1,491,330	1,557,436	1,625,854	1,696,686	1,770,036	1,845,986
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RETRACT - Market 0	5.0%	(16,230)	(17,042)	(17,896)	(18,788)	(19,728)	(20,714)	(21,750)	(22,837)	(23,979)	(25,178)	(26,437)	(27,759)	(29,147)	(30,604)	(32,134)	(33,740)	(35,426)
- Low/Mod	3.0%	(17,697)	(18,229)	(18,777)	(19,340)	(19,926)	(20,533)	(21,163)	(21,816)	(22,491)	(23,190)	(23,914)	(24,663)	(25,437)	(26,236)	(27,061)	(27,913)	(28,793)

EFFECTIVE GROSS RESIDENTIAL INCOME	898,519	911,185	947,106	982,390	1,019,499	1,063,605	1,110,085	1,159,621	1,209,305	1,262,233	1,317,506	1,375,330	1,435,513	1,498,471	1,564,235	1,632,910	1,704,523	1,779,210
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CONCRETE INCOME	3.0% incl.	34,338	35,364	36,429	37,522	38,647	39,807	41,001	42,231	43,498	44,803	46,147	47,531	48,957	50,426	51,939	53,496	55,099
Less: vacancy 0	10.0%	(3,434)	(3,537)	(3,643)	(3,752)	(3,865)	(3,981)	(4,100)	(4,223)	(4,350)	(4,480)	(4,615)	(4,753)	(4,896)	(5,043)	(5,194)	(5,349)	(5,508)
LIQUIDITY INCOME	4.0% incl.	3,312	3,444	3,582	3,726	3,875	4,030	4,191	4,358	4,531	4,714	4,903	5,099	5,303	5,515	5,735	5,964	6,202
Less: vacancy 0	5.0%	(166)	(172)	(179)	(186)	(194)	(201)	(210)	(218)	(227)	(236)	(245)	(255)	(265)	(276)	(287)	(298)	(309)

EFFECTIVE NET RENT INCOME	914,619	948,288	983,235	1,019,658	1,057,557	1,103,259	1,150,967	1,200,765	1,252,759	1,307,034	1,363,686	1,422,851	1,484,612	1,549,094	1,616,418	1,686,561	1,759,524	1,835,311
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SPONSOR OPERATING SUBSIDY: LIQUIDITY	258,526	245,721	232,619	219,188	205,433	185,339	164,513	142,931	120,559	97,403	73,408	48,560	22,833	0	0	0	0	0
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EFFECTIVE GROSS TOTAL INCOME	1,173,145	1,194,018	1,215,915	1,238,846	1,262,999	1,288,598	1,315,480	1,343,700	1,373,328	1,404,437	1,437,104	1,471,412	1,507,444	1,545,094	1,584,418	1,625,410	1,668,044	1,712,311
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OPERATING EXPENSES INCLUDING:

ADMINISTRATIVE

Management Fee	5.0% of RFI	44,028	45,659	47,355	49,119	50,955	52,860	54,844	56,907	59,049	61,279	63,598	65,907	68,307	70,799	73,384	76,064	78,839
Payroll Expenses		28,511	30,000	31,500	33,075	34,729	36,465	38,284	40,203	42,231	44,368	46,514	48,671	50,840	53,021	55,214	57,429	59,656
Payroll Taxes & Benefits		10,000	10,500	11,025	11,576	12,155	12,763	13,401	14,071	14,775	15,513	16,289	17,103	17,955	18,846	19,776	20,746	21,756
Legal		4,762	5,000	5,250	5,513	5,788	6,078	6,381	6,700	7,036	7,387	7,757	8,144	8,552	8,979	9,426	9,894	10,382
Lease		7,619	8,000	8,400	8,820	9,261	9,724	10,210	10,721	11,257	11,820	12,411	13,031	13,683	14,367	15,085	15,838	16,626
Marketing Expenses		5,029	5,280	5,544	5,821	6,112	6,418	6,739	7,076	7,429	7,801	8,191	8,601	9,031	9,482	9,956	10,454	10,984
Telephone		3,771	3,960	4,158	4,366	4,584	4,813	5,054	5,307	5,572	5,851	6,143	6,450	6,773	7,112	7,467	7,839	8,226
Office Supplies		1,905	2,000	2,100	2,205	2,315	2,431	2,553	2,680	2,814	2,955	3,103	3,258	3,421	3,592	3,771	3,958	4,154
Accounting & Data Processing		6,487	6,811	7,152	7,509	7,885	8,279	8,693	9,127	9,584	10,063	10,566	11,094	11,648	12,228	12,833	13,464	14,121
Rent: FOOD admin fee @ \$50/month		4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
Other Misc		762	800	840	882	926	972	1,021	1,072	1,126	1,182	1,241	1,303	1,368	1,437	1,509	1,584	1,661
SUBTOTAL ADMINISTRATIVE		117,334	122,410	127,724	133,286	139,110	145,523	152,245	159,288	166,670	174,407	182,515	191,014	199,920	209,235	218,960	229,104	239,669

0.0% incl

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UTILITIES		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Payroll Expenses		43,000	45,150	47,400	49,718	52,567	54,410	57,624	60,505	63,531	66,707	70,042	73,545	77,222	81,043	85,137
Payroll Taxes & Benefits		15,100	15,855	16,646	17,410	18,354	19,272	20,235	21,247	22,310	23,425	24,596	25,816	27,117	28,473	29,897
Janitorial Materials & Services		2,514	2,660	2,772	2,911	3,056	3,209	3,359	3,518	3,715	3,900	4,096	4,300	4,515	4,741	4,978
Landscaping / Open Space Maint.		3,352	3,520	3,696	3,881	4,075	4,279	4,493	4,717	4,953	5,201	5,461	5,734	6,020	6,321	6,637
Decorating (interior only)		11,429	12,000	12,600	13,220	13,892	14,586	15,315	16,081	16,885	17,729	18,616	19,547	20,524	21,550	22,638
Repairs		23,048	24,200	25,410	26,681	28,015	29,415	30,816	32,420	34,052	35,754	37,543	39,419	41,390	43,460	45,633
Elevator Maintenance		3,771	3,960	4,158	4,366	4,584	4,813	5,054	5,307	5,572	5,851	6,143	6,450	6,773	7,112	7,467
Garbage & Trash Removal		1,905	2,000	2,100	2,205	2,317	2,431	2,552	2,680	2,816	2,955	3,103	3,258	3,421	3,592	3,771
Snow Removal		1,676	1,760	1,848	1,940	2,037	2,139	2,246	2,359	2,476	2,600	2,730	2,867	3,010	3,161	3,319
Landscaping		3,352	3,520	3,696	3,881	4,075	4,279	4,493	4,717	4,953	5,201	5,461	5,734	6,020	6,321	6,637
Resident Services		1,905	2,000	2,100	2,205	2,315	2,431	2,553	2,680	2,814	2,955	3,103	3,258	3,421	3,592	3,771
Miscellaneous		952	1,000	1,050	1,103	1,158	1,216	1,276	1,340	1,407	1,477	1,551	1,629	1,710	1,796	1,886
SUBTOTAL UTILITIES		112,005	117,605	123,485	129,660	136,142	143,950	150,097	157,602	165,482	173,756	182,444	191,566	201,144	211,292	221,763
SECURITY		29,120	29,848	30,594	31,359	32,143	32,947	33,770	34,615	35,480	36,367	37,276	38,208	39,163	40,142	41,146
UTILITIES		2,508 incl.														
Electricity		26,400	27,720	29,106	30,561	32,089	33,694	35,379	37,147	39,005	40,955	43,003	45,153	47,411	49,781	52,270
Gas		41,360	43,428	45,599	47,879	50,273	52,787	55,426	58,198	61,108	64,163	67,371	70,740	74,277	77,990	81,890
Water & Sewer		33,440	35,781	38,285	40,965	43,833	46,901	50,184	53,697	57,456	61,478	65,782	70,386	75,313	80,595	86,236
SUBTOTAL UTILITIES		101,200	106,929	112,991	119,406	126,196	133,382	140,989	149,042	157,589	166,596	176,155	186,279	197,001	208,357	220,316
TELE ESTIM. TAXES		52,400	54,120	55,473	56,860	58,281	59,738	61,232	62,763	64,332	65,940	67,588	69,278	71,010	72,785	74,605
TELEPHONE		24,200	25,410	26,681	28,015	29,415	30,816	32,420	34,052	35,754	37,542	39,419	41,390	43,460	45,633	47,914
UTILITIES EXPENSES - RESIDENTIAL		436,659	456,322	476,944	498,585	521,248	545,416	570,763	597,382	625,287	654,608	685,399	717,735	751,698	787,376	824,853
REPLACEMENT ASSETS		24,200	25,410	26,681	28,015	29,415	30,816	32,420	34,052	35,754	37,542	39,419	41,390	43,460	45,633	47,914
TOTAL EXPENSES		460,859	481,732	503,625	526,600	550,703	576,232	603,184	631,434	661,041	692,150	724,818	759,125	795,158	833,007	872,767
NET OPERATING INCOME		713,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	712,216	716,087
DEBT SERVICE COVERAGE RATIO		647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533	647,533
DEBT SERVICE COVERAGE RATIO		64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753	64,753
SPONSOR OPERATING SUBSIDY ESCROW		0	1,324,375	1,423,703	1,521,621	973,123	826,920	603,506	549,430	426,124	315,153	218,221	137,184	74,065	31,060	10,557
Escrow Starting Balance		1,100,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deposits - Liabage		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity Investor Payments		200,000	0													
Total Annual Deposits		1,300,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest @ 7.50%		24,375	39,328	106,778	95,397	84,122	72,984	62,019	51,263	41,207	31,959	23,636	16,367	10,289	5,555	2,329
(3 months)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Subsidy Payment - Liabage		0	258,526	245,731	232,619	219,188	205,433	185,339	164,513	142,931	120,569	97,403	73,408	48,560	22,833	0
Operating Subsidy Payment - Equity		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Escrow Ending Balance		1,324,375	1,423,703	1,521,621	973,123	826,920	603,506	549,430	426,124	315,153	218,221	137,184	74,065	31,060	10,557	11,340
Initial Balance		10,557														12,200

APPENDIX C: TRANSPORTATION



IV. Transportation Component
Off-Site Parking

1.0 INTRODUCTION

1.1 Background and Purpose

This transportation study has been undertaken for the New England Medical Center, Inc., Tufts/New England Medical Center, Inc., Asian Community Development Corporation (ACDC) and the Chinatown Economic Development Corporation (CEDC) to assess in a comprehensive way the transportation impacts of several projects in the South Cove area of downtown Boston (Figure 1.1 - Location Map) which will be implemented over the next ten years.

The New England Medical Center (NEMC) is in the midst of a ten year master planning effort which will guide the area's growth to the year 2000. An additional 252,000 square feet of floor space is proposed for development within this time frame. In the past ten years, the New England Medical Center area has grown and changed considerably, under constant scrutiny by community groups in neighboring Chinatown, South Cove, Bay Village and the South End, who wish to protect neighborhood interests as the institutions expand.

At the same time, both the Asian Community Development Corporation and the Chinese Economic Development Corporation have been pursuing plans for new housing on two redevelopment parcels. In addition, the Boston Redevelopment Authority has been working with the community to develop a community center on a third parcel. Each of these projects are expected to be implemented within the same time frame as that covered by the NEMC Master Plan.

Given the narrow streets and heavily used parking facilities in the area, a major concern is transportation for both current and new employees, patients and visitors. For this reason, the Boston Redevelopment Authority and the Boston Transportation Department have requested that a transportation study be conducted to cover both NEMC and community proposals. The study must also serve as part of the Environmental Impact Report (EIR) required by the Massachusetts Environmental Policy Act (MEPA) unit of the Executive Office of Environmental Affairs. Subsequent to "scoping sessions," through which the City agencies and MEPA outlined specific study requirements, the four organizations retained Howard/Stein-Hudson Associates as transportation consultants to carry out the required study.

1.2 Description of Projects

The study covers the following specific projects, as shown in Figure 1.2 - Study Area and Proposed Development.

- NEMC Phase 1-C developments, as defined in the Master Plan. These proposals include 252,000 SF of new development providing 196 new beds in two buildings, along with research uses:
 - 1-C North: 171,025 square feet; and
 - 1-C South: 80,944 square feet.

In addition, the emergency entrance of the hospital will be relocated from Harrison Avenue to Washington Street.

- To accommodate parking for the Phase 1-C project and replacement parking for spaces lost on Parcels A, B, and C, a reconstruction and expansion of the Herald Street Garage is also proposed.
- Housing on Parcel A, proposed by the Chinese Economic Development Council (CEDC) and known as Mei Wah Village, includes 141 rental units and 160 parking spaces.
- Housing on Parcel B, proposed by the Asian Community Development Corporation (ACDC), includes 120 rental units and 90 parking spaces.
- A 90,000 square foot recreation center is proposed for Parcel C. No parking is proposed at this time.

To provide some context for the proposed NEMC development, it may be pointed out that the current NEMC establishment consists of 1,357,000 SF of hospital, research, and office/support uses. Thus, the 252,000 SF of new development covered by the EIR represents an increase of 18.6% in existing NEMC floor area. *Longer range NEMC development has been proposed, including Phase 2 and Phase 3 buildings, and a proposed Research Building, but these projects are not specifically analyzed in this report, as implementation is planned beyond the year 2000.*

1.3 Methodology and Data Sources

This study utilizes established transportation planning procedures to ascertain existing transportation conditions -- traffic, parking, transit and pedestrian -- in the study area. With this as a base, the impacts of the project and other likely developments in the general area by the year 2000 are estimated and added to the base case. Impacts are measured in

terms of traffic Level of Service (LOS)/ capacity analyses, parking supply and demand, transit service sufficiency, and pedestrian conditions. Finally, measures for the mitigation of negative impacts are proposed.

In addition, to supplement and document existing traffic volume counts from available reports, peak period intersection turning movement traffic counts and 24-hour Automatic Traffic Recorder (ATR) counts were conducted in January through April of 1990. To document pedestrian conditions, AM and PM peak period and lunchtime peak hour counts were conducted in January, 1990. All count summaries are included in Appendix A.

To firmly establish travel characteristics, a survey of NEMC and Tufts employees, faculty, staff and students was conducted during February, 1990 to document existing travel patterns and to update survey data collected for NEMC in 1986 by Vanasse Hangen. Survey findings are discussed later in this report.

1.4 Report Organization

This report presents the study analyses and findings in the following sections:

2. Existing Conditions;
3. Future Trip Generation;
4. Impacts of Projects;
5. Mitigating Measures.

2.0 EXISTING CONDITIONS

2.1 Study Area

The study area and proposed projects are shown in Figure 1.2, above. For purposes of traffic analysis, a broad study area encompassing roadways used for access to and from the regional expressway system both from parking facilities north of the Massachusetts Turnpike and the fringe parking garage across the Turnpike on Herald Street was specified. The study area includes 27 intersections, as shown later in Figure 2.2 - Traffic Impact Area and Intersections Analyzed. Subareas were also defined for purposes of analyzing the individual housing developments and the community center on Parcels A, B, and C. These definitions will be discussed in Section 2.5, which describes the traffic levels of service analyses.

2.2 Demographic Profile

To give an indication of daily employee, visitor, and resident population within the study area, the following profile was developed through interviews with administrative personnel.

Floor Space

Floor space by use type for New England Medical Center and Tufts University is summarized in Table 2.1.

The New England Medical Center occupies 1,356,992 square feet of floor space in 18 facilities within the study area. The major inpatient facilities are the Proger, Pratt, Farnsworth, Floating Hospital, Rehab and Center Buildings, which account for 56% of total floor space. Each of these facilities also accommodates some office, research, and support space as well.

Table 2.1
Gross Floor Area by Institution

<u>Institution/Building</u>	<u>1990 Gross Floor Area of Occupied Space</u>	<u>Primary Use</u>
New England Medical Center		
Proger	221,579	Inpatient, labs, admin, offices, research, support
Pratt	51,766	Inpatient, ambulatory, admin, office, support
Farnsworth	104,044	Inpatient, ambulatory, admin, office, support
Floating	282,390	Inpatient, office, support, labs, admin
Biewend	145,564	Ambulatory care, office, admin, labs, support
Ziskind	100,955	Research, office, support, labs
Rehab	54,716	Inpatient, emergency, admin, office, research
Center	49,064	Inpatient, office, ambulatory, support
Boston Dispensary	46,386	Research, ambulatory, office, support, admin
MRI	12,667	Diagnostic services, research
Jackson	23,562	Administration
Common Services	15,039	Administration, support
Tupper (15 Kneeland)	110,510	Research and administration
35 Kneeland	103,565	Training, administration
Holmes	16,076	Administration
17 Nassau	5,587	Credit Union, Research Finance, and T/NEMC
Hemenway	10,450	Administration
Nursing Education	3,072	Nursing Education, Classrooms
Total New England Medical Center: 1,356,992		
Tufts University		
M & V Building	124,301	Research & Teaching
Sterns Building	56,447	Research & Teaching
Arnold Building	57,381	Research & Teaching
South Cove Building	44,749	Research & Teaching
Dental Building	215,715	Teaching & Clinic
HNRC Building	204,430	Research
Sackler Building	134,817	Teaching & Administration
193 Harrison	5,560	Administration
203 Harrison	4,061	Administration
Posner	62,383	Administration & Dormitory
Total Tufts University: 909,844		

Tufts University occupies 909,844 square feet of floor space in 10 buildings, of which the largest are the Dental Building and the HNRC building. About 838,000 square feet is devoted to research and teaching, with the remaining space devoted to administration, and a dormitory in the Posner Building, which accommodates 96 students in single rooms.

Daily On-site Population and Employment

Estimates of daily population and employment for the Medical Center and Tufts University are provided in Table 2.2. As shown, the Tufts University Medical and Dental Schools attract around 3,500 students, faculty, clerical and support staff during the weekdays. Due to variations in weekly schedules, however, it is not likely that the maximum population of faculty and students would be on site at any one time. In addition, a small number of nurses and physical plant maintenance staff are present for the evening and night shifts.

At New England Medical Center, approximately 3,000 employees work a standard day shift. Another 400 work from 7:00 AM to 3:00 PM, 260 work from 3:00 PM to 11:00 PM, and 200, including nurses, on call residents, and physical plant staff, work from 11:00 PM to 7:00 AM.

Numerous other Chinatown neighborhood and citywide institutions contribute to the daytime population in the study area. Don Bosco High School accommodates 608 students and 52 staff each day. The Josiah Quincy Elementary School serves 75-100 half time kindergarten students and 700 elementary students. The Quincy School Community Council's human services programs for children and adults, Golden Age Center programs for the elderly, and South Cove Health Center bring 800 or more clients and others to the area each day, both on foot from nearby Chinatown and the South End, and from other areas.

Residential Population

Residential population in Chinatown¹ was over 5,100 in 1987², with a large propor

1. Defined by the Boston Redevelopment Authority as the area bounded by Essex Street, the Surface Artery, Stuart/Kneeland Street and Washington Street, as outlined in Figure 1.2

2. Boston Redevelopment Authority. Kingston-Bedford-Essex Street Development Draft Environmental Impact Report, April, 1989.

Table 2.2
Tufts University and NEMC Daytime Population

Daily Population:

<u>Institution</u>	Employees by Shift:				Faculty/ Physic.	<u>Students</u>	<u>TOTAL</u>
	<u>Day</u>	<u>7-3</u>	<u>3-11</u>	<u>11-7</u>			
NEMC	3,000	400	260	200	0	0	3,860
Tufts Univ.	1,418	0	0	21	420	1,625	3,484
TOTAL	4,418	400	260	221	420	1,625	7,044

tion of "traditional, ethnic families that are less affluent," according to the BRA.³ Chinatown is primarily home to first generation Chinese immigrants. Ninety one percent of the residents are Chinese, while two percent are Cambodian, Vietnamese, or other Asian nationalities.

In 1985, most Chinatown residents lived in rented dwelling units, and rents were still well below the Boston average. The housing stock is a mixture of older three to five story rowhouses, and ten or twenty story housing developments built during the urban renewal era. There are approximately 1,500 housing units in the neighborhood, nearly one-half of which are in large subsidized projects. Mass. Pike Towers has 850 tenants and 7 staff people; Quincy Towers has 175 tenants and 5 staff; Tai Tung Village has 214 units and 16 storefronts.

2.3 Travel Modes of Residents, Employees, Visitors, and Patients

Travel modes of the current population working in, living in, or visiting the study area were obtained from several sources, as described below.

Residents

Work trip travel patterns for existing residents of the area were obtained from the U.S. Census 1980 Journey to Work data compiled by the Central Transportation Planning Staff, the Boston region's transportation planning agency. Work trip characteristics were chosen as most characteristic of peak hour travel. These data, for traffic zone 53, showed that, of residents living in Zone 53:

- 9% drive alone and 25% travel in carpools, yielding an average auto occupancy of 2.1 persons/vehicle;
- 10% go to work by public transportation; and
- 56% go to work by walking, bicycle, taxi, motorcycle or other means.

This is a much lower auto use rate than for Boston neighborhoods as a whole, reflecting the low auto ownership rate in this neighborhood. In 1980, 67% of Chinatown households owned no cars; 31% owned one car, and 2% owned 2 cars. No households owned more than 2 cars. The high carpool rate is also of interest, probably reflecting the heavy use of vans to transport restaurant workers from Chinatown to other neighborhoods in Boston and other communities. Average car occupancy was 2.1 persons per vehicle, almost twice the average for other Boston neighborhoods.

3. Boston Redevelopment Authority. Draft: Central District Neighborhood Profile, 1988.

Visitors and Patients

Visitor and patient travel patterns for the NEMC were derived from surveys conducted by VHB in the 1986 Parking Needs and Site Evaluation Study. While this survey did not reflect the opening of the new Orange Line station at the Medical Center, it showed that:

- 60% of NEMC visitors came by auto;
- 29% used transit; and
- 11% walked or used other modes.

Employees

Through the City of Boston scoping meetings, it was determined that new data collection was necessary to update employee travel data to ascertain the effects of the new Orange Line station was necessary. Thus, a self-administered one-page survey was distributed to NEMC, Tufts and TNEMC employees in February, 1990.

Complete and valid surveys were received from 1,467 respondents. About 8,000 surveys were distributed, yielding a response rate of about 18%. This is more than adequate to identify existing travel patterns and modes to/from the area.

A comparison of the 1990 Howard/Stein-Hudson survey results to the Vanasse/Hangen survey of 1986 is presented in Tables 2.3, 2.4 and 2.5 for Mode Choice, Subway Riders by Station and Bus Riders by Route, respectively. Table 2.6 identifies the Trip Distribution for those traveling to/from the area by all modes.

Mode Choice - The survey results for mode choice (identified for employees, staff and students only and not visitors and patients) indicate that overall vehicle use within the medical area as a whole (NEMC plus Tufts population) has increased approximately 7%, from 46.4% to 53.2%. This increase is equally distributed between solo drivers and passengers in an auto (carpoolers). It also appears the walk and bicycle/motorcycle modes have decreased over the four year period and switched to auto mode. This minor shift could be a result of the season in which the surveys were conducted (May 1986 vs. February 1990).

While the 7% overall increase in vehicle use seems high, it is important to note that, if one views NEMC employees as a separate group, the comparative results for auto drivers were not significantly different. The percentage of drivers changed from 44.7% in the V/H survey to 47.2% in the more recent H/S-H survey. Comparison of the two survey groups indicates that this change of 2.5% is not statistically significant.

Table 2.3
Transportation Mode of NEMC Employees - 1986 and 1990

<u>Mode</u>	V/H Survey: 1986						H/S-H Survey: 1990					
	NEMCH Staff		Tufts-Related		Total		NEMCH Staff		Tufts-Related		Total	
	<u>Freq</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct</u>
Drive	343	44.7%	80	28.0%	423	40.2%	523	47.5%	144	39.6%	667	45.7%
Passenger	15	2.0%	5	1.7%	20	1.9%	41	3.7%	21	5.7%	62	4.2%
Dropped Off	37	4.8%	9	3.1%	46	4.4%	40	3.6%	8	2.3%	48	3.3%
Total Auto	395	51.5%	94	32.9%	489	46.4%	604	54.8%	173	47.6%	777	53.2%
Subway	245	31.9%	120	42.0%	365	34.7%	341	31.0%	110	30.2%	451	30.9%
Bus	46	6.0%	9	3.1%	55	5.2%	63	5.7%	24	6.6%	87	6.0%
Comm. Rail	27	3.5%	9	3.1%	36	3.4%	64	5.8%	35	9.6%	99	6.8%
Comm. Boat	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.8%	3	0.2%
Total Transit	318	41.5%	138	48.3%	456	43.3%	468	42.5%	172	47.2%	640	43.8%
Taxi	4	0.5%	0	0.0%	4	0.4%	1	0.0%	0	0.0%	1	0.1%
Walk	29	3.8%	41	14.3%	70	6.6%	23	2.2%	8	2.2%	31	2.1%
Bicycle/ Motorcycle	13	1.7%	13	4.5%	26	2.5%	0	0.0%	6	1.6%	6	0.1%
Vanpool/ Carpool	8	1.0%	0	0.0%	8	0.8%	5	0.5%	5	1.4%	10	0.7%
TOTAL	767	100.0%	286	100.0%	1053	100.0%	1101	100.0%	364	100.0%	1465	100.0%

Table 2.4
Subway Riders by Station

<u>STATION</u>	V/H Survey 1986		H/S-H Survey 1990	
	<u>Frequency</u>	<u>Percent</u>	<u>Frequency</u>	<u>Percent</u>
ORANGE:				
Back Bay	na	0.0%	3	0.6%
NE Medical Ctr.	na	0.0%	363	68.0%
Chinatown	227	42.0%	3	0.6%
North Station	0	0.0%	1	0.2%
RED:				
Broadway	8	1.5%	5	0.9%
South Station	0	0.0%	24	4.5%
Downtown Crossing	83	15.4%	49	9.2%
Park Street	45	8.3%	15	2.8%
GREEN:				
Copley	3	0.6%	0	0.0%
Arlington	2	0.4%	0	0.0%
Boylston	167	30.9%	71	13.3%
BLUE:				
State	5	0.9%	0	0.0%
TOTAL	540	100.0%	534	100.0%

Table 2.5
Bus Riders by Route

<u>MODE</u>	<u>V/H Survey</u> 1986		<u>H/S-H Survey</u> 1990	
	<u>Frequency</u>	<u>Percent</u>	<u>Frequency</u>	<u>Percent</u>
Route 9	0	0.0%	4	6.5%
Route 11	36	53.7%	21	33.9%
Route 39	1	1.5%	0	0.0%
Route 43	1	1.5%	2	3.2%
Route 49	1	1.5%	6	9.7%
Route 55	2	3.0%	3	4.8%
Route 92	0	0.0%	1	1.6%
Route 93	1	1.5%	0	0.0%
Route 300	3	4.5%	4	6.5%
Route 301	10	14.9%	7	11.3%
Route 304	6	9.0%	5	8.1%
Route 305	6	9.0%	6	9.7%
Route 352	0	0.0%	2	3.2%
Route 441	0	0.0%	1	1.6%
TOTAL	67	100.0%	62	100.0%

Table 2.6
Regional Trip Distribution: Auto Drivers and Passengers

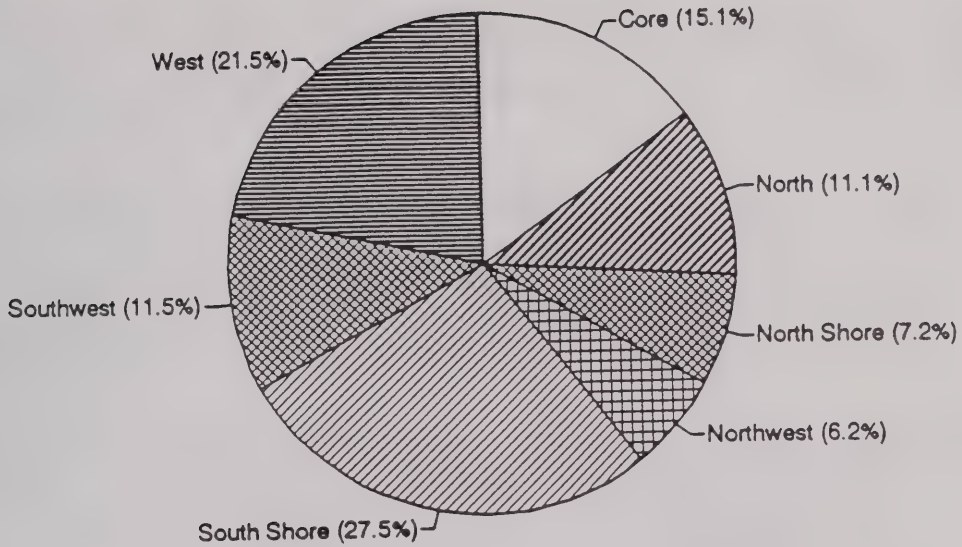
<u>DIRECTION/CORRIDOR</u>	<u>DRIVE</u>		<u>PASSENGER</u>		<u>DROP OFF</u>		<u>TOTAL AUTO</u>	
	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>	<u>Freq.</u>	<u>Prct.</u>
CORE:								
Core	100	15.0%	4	6.5%	13	27.1%	117	15.1%
Subtotal	100	15.0%	4	6.5%	13	27.1%	117	15.1%
NORTH:								
NH/MA	23	3.4%	1	1.6%	0	0.0%	24	3.1%
North Inner	30	4.5%	2	3.2%	2	4.2%	34	4.4%
North Outer	23	3.4%	4	6.5%	1	2.1%	28	3.6%
Subtotal	76	11.4%	7	11.3%	3	6.3%	86	11.1%
NORTH SHORE:								
NH/ME/MA	11	1.6%	0	0.0%	2	4.2%	13	1.7%
North Shore Inner	13	1.9%	2	3.2%	2	4.2%	17	2.2%
North Shore Outer	17	2.5%	8	12.9%	1	2.1%	26	3.3%
Subtotal	41	6.1%	10	16.1%	5	10.4%	56	7.2%
NORTHWEST:								
Northwest Inner	17	2.5%	3	4.8%	0	0.0%	20	2.6%
Northwest Outer	23	3.4%	1	1.6%	1	2.1%	25	3.2%
Western MA North	3	0.4%	0	0.0%	0	0.0%	3	0.4%
Subtotal	43	6.4%	4	6.5%	1	2.1%	48	6.2%
SOUTH SHORE:								
Cape Cod	6	0.9%	1	1.6%	0	0.0%	7	0.9%
South Shore Inner	79	11.8%	5	8.1%	10	20.8%	94	12.1%
South Shore Outer	72	10.8%	5	8.1%	4	8.3%	81	10.4%
Southeast MA	29	4.3%	3	4.8%	0	0.0%	32	4.1%
Subtotal	186	27.9%	14	22.6%	14	29.2%	214	27.5%
SOUTHWEST:								
RI/MA	9	1.3%	2	3.2%	1	2.1%	12	1.5%
Southwest Inner	37	5.5%	7	11.3%	5	10.4%	49	6.3%
Southwest Outer	24	3.6%	2	3.2%	2	4.2%	28	3.6%
Subtotal	70	10.5%	11	17.7%	8	16.7%	89	11.5%
WEST:								
West Inner	80	12.0%	9	14.5%	2	4.2%	91	11.7%
West Outer	65	9.7%	3	4.8%	2	4.2%	70	9.0%
Western MA South	6	0.9%	0	0.0%	0	0.0%	6	0.8%
Subtotal	151	22.6%	12	19.4%	4	8.3%	167	21.5%
TOTAL	667	100.0%	62	100.0%	48	100.0%	777	100.0%

Table 2.7
Regional Trip Distribution: Transit Users

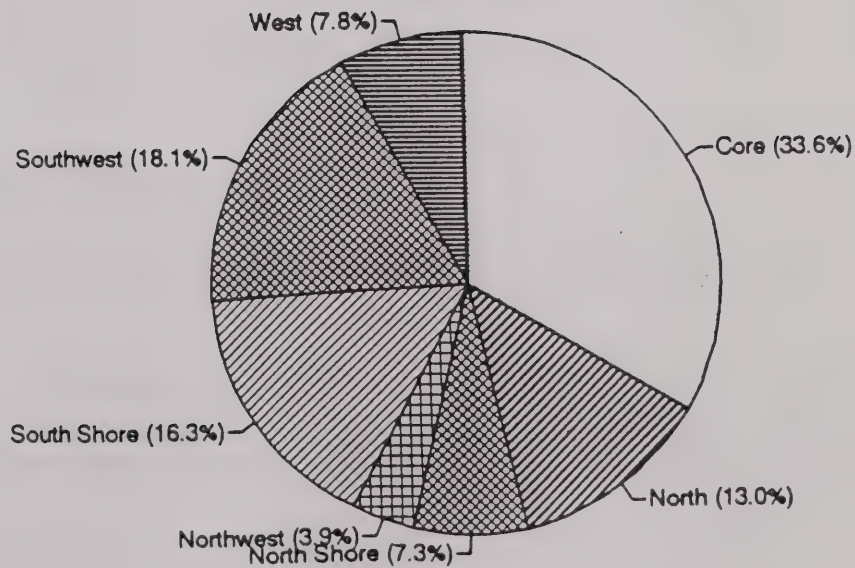
<u>Direction/Corridor</u>	<u>Subway</u>		<u>Bus</u>		<u>Commuter Bus</u>		<u>Commuter Rail</u>		<u>Commuter Boat</u>		<u>Total Transit</u>	
	<u>Freq.</u>	<u>Pct.</u>	<u>Freq.</u>	<u>Pct.</u>	<u>Freq.</u>	<u>Pct.</u>	<u>Freq.</u>	<u>Pct.</u>	<u>Freq.</u>	<u>Pct.</u>	<u>Freq.</u>	<u>Pct.</u>
CORE:												
Core	169	37.5%	43	53.8%	0	0.0%	3	3.0%	0	0.0%	215	33.6%
Subtotal	169	37.5%	43	53.8%	0	0.0%	3	3.0%	0	0.0%	215	33.6%
NORTH:												
NH/MA	4	0.9%	1	1.3%	0	0.0%	4	4.0%	0	0.0%	9	1.4%
North Inner	51	11.3%	0	0.0%	0	0.0%	4	4.0%	0	0.0%	55	8.6%
North Outer	13	2.9%	0	0.0%	0	0.0%	6	6.1%	0	0.0%	19	3.0%
Subtotal	68	15.1%	1	1.3%	0	0.0%	14	14.1%	0	0.0%	83	13.0%
NORTH SHORE:												
NH/ME/MA	3	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.5%
North Shore Inner	19	4.2%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	20	3.1%
North Shore Outer	17	3.8%	1	1.3%	0	0.0%	6	6.1%	0	0.0%	24	3.8%
Subtotal	39	8.6%	1	1.3%	0	0.0%	7	7.1%	0	0.0%	47	7.3%
NORTHWEST:												
Northwest Inner	12	2.7%	1	1.3%	0	0.0%	0	0.0%	0	0.0%	13	2.0%
Northwest Outer	4	0.9%	2	2.5%	0	0.0%	4	4.0%	0	0.0%	10	1.6%
Western MA North	0	0.0%	0	0.0%	0	0.0%	2	2.0%	0	0.0%	2	0.3%
Subtotal	16	3.5%	3	3.8%	0	0.0%	6	5.1%	0	0.0%	25	3.9%
SOUTH SHORE:												
Cape Cod	1	0.2%	0	0.0%	3	42.9%	0	0.0%	0	0.0%	4	0.6%
South Shore Inner	53	11.8%	4	5.0%	0	0.0%	1	1.0%	0	0.0%	58	9.1%
South Shore Outer	23	5.1%	1	1.3%	1	14.3%	0	0.0%	3	100.0%	28	4.4%
Southeast MA	4	0.9%	6	7.5%	2	28.6%	2	2.0%	0	0.0%	14	2.2%
Subtotal	81	18.0%	11	13.8%	6	85.7%	3	3.0%	3	3.0%	104	16.3%
SOUTHWEST:												
RI/MA	2	0.4%	1	1.3%	1	14.3%	12	3.0%	16	2.5%	16	2.5%
Southwest Inner	54	12.0%	4	5.0%	0	0.0%	5	5.1%	0	0.0%	63	9.8%
Southwest Outer	5	1.1%	0	0.0%	0	0.0%	32	32.3%	0	0.0%	37	5.8%
Subtotal	61	13.5%	5	6.3%	1	14.3%	49	49.5%	16	2.5%	116	18.1%
WEST:												
West Inner	13	2.9%	14	17.5%	0	0.0%	3	3.0%	0	0.0%	30	4.7%
West Outer	4	0.9%	2	2.5%	0	0.0%	12	12.1%	0	0.0%	18	2.8%
Western MA South	0	0.0%	0	0.0%	0	0.0%	2	2.0%	0	0.0%	2	0.3%
Subtotal	17	3.8%	16	20.0%	0	0.0%	17	17.2%	0	0.0%	50	7.8%
TOTAL	451	100.0%	80	100.0%	7	100%	99	100.0%	3	100.0%	640	100.0%

Figure 2-1

REGIONAL TRIP DISTRIBUTION AUTO DRIVERS



REGIONAL TRIP DISTRIBUTION TRANSIT USERS



Auto occupancy for NEMC employees who said they had driven an auto to work was also about the same as that noted in the prior survey -- 1.09 on average as opposed to 1.08 in the prior survey. When overall auto occupancy for all who came by auto -- drivers, passengers and those who were dropped off -- is calculated, however, the average rises to 1.15 for NEMC employees and 1.2 for Tufts employees, with 1.16 the overall average.

Overall transit use has remained relatively constant from about 43.3% in 1986 to 43.8% in 1990. However, a 3% shift in mode share from transit to commuter rail has resulted, presumably due to the resumption of commuter rail service along the Needham Branch since the 1986 survey.

Subway Riders - As expected, the survey indicates a shift in subway station use to the New England Medical Center, with approximately 68% of all subway riders using this station. In addition, South Station exhibits an increase in usage. Subway stations that show a reduction in usage due to the survey responses include the Chinatown, Downtown Crossing, Park Street and Boylston stations.

Bus Riders - According to the survey results, bus ridership has increased insignificantly from 5.2% to 6.0%. The most heavily used bus route is Route 11 from South Boston. Route 49 from Roxbury and the South End has increased significantly since the Orange Line has been relocated. Other more heavily used bus routes include those express busses terminating in downtown such as Route 301 from Brighton, 305 from Waltham, 304 from Watertown and the 300 from Riverside.

Trip Distribution - Regional trip distribution identified in the survey results is presented in Table 2.6 for auto drivers and passengers and Table 2.7 for transit riders. These percentages are summarized in Figure 2-1. As shown, the primary corridor for auto drivers is the South Shore, accounting for 27.5% of auto drivers and passengers. The West corridor accounts for 21% of auto users. In contrast, about a third of transit riders come predominantly from the core area, comprising most of Boston, Brookline, and Cambridge. Eighteen percent come from the Southwest (good Orange Line and commuter rail access), and 16% from the South Shore (Red Line access).

2.4 Street Network and Circulation

The traffic impact study area and intersections identified for analysis are presented in Figure 2.2.

As shown, 27 intersections have been included in the study area, covering the medical area itself, and the primary fringe parking garage on Herald Street. The intersections include the major entry and exit points from the Southeast Expressway and Massachusetts Turnpike.

2.5 Traffic Volumes

Average daily traffic volumes for the study area are shown in Figure 2.3. AM and PM peak hour volumes are shown in Figure 2.4 and 2.5. As shown, average daily traffic is heaviest on major arterials serving the expressway system such as Frontage Road, Albany Street, E. Berkeley Street, and Herald Street. Other arterials such as Stuart/Kneeland, Tremont Street, Marginal Road, and Washington Street serve moderate volumes. Streets internal to the Medical Area -- Harrison Ave., Tyler Street, Oak Street, Hudson Street -- serve low traffic volumes.

In the peak hours, the heaviest traffic flows occur along the expressway access routes, primarily along major arterials; i.e., the Stuart/Kneeland Street corridor, Albany Street, Frontage Road, Herald Street, Marginal Road, and E. Berkeley Street.

2.6 Traffic Level of Service (LOS) Analysis

Evaluation of the operating conditions at the 27 analysis intersections was made through Level of Service (LOS) calculations in the traffic peak hours. A fuller description of the LOS analyses, done in conformance with the "Highway Capacity Manual", is given in the Appendix. In brief, LOS are defined in the range of A to F, from best to worst, representing levels of average delay per vehicle (less than 5 seconds for A, greater 60 seconds for F). LOS A indicates little or no delay, with practically all traffic clearing a signal on the same cycle (green-red-green sequence) in which it arrives. At lower LOS, delays increase, with higher proportions of traffic having to wait for the next or subsequent cycles. LOS D is considered satisfactory for urban conditions. The capacity, or maximum number of vehicles which can pass through an intersection, is experienced at LOS E, short of LOS F, or flow breakdown conditions. Capacity is generally expressed as a volume to capacity ratio (V/C ratio), with values greater than one generally corresponding to LOS F.

Intersection levels of service are shown under existing (1989) conditions in Table 2-8.

As shown, only two intersections operate at unacceptable conditions (worse than LOS D). These deficient conditions occur during the morning peak hour (7:45 to 8:45 AM) and are located within the Central Artery/Tunnel project boundaries at the intersections of Herald/Frontage/Broadway Bridge and East Berkeley/Frontage/W. Fourth St. Bridge. During the morning peak hour, all other intersection locations operate at or above LOS C.

During the evening peak hour (4:30 to 5:30 PM), no intersection in the study area operates below LOS D. Those locations at LOS D are limited to locations along the Kneeland Street and Herald Street corridors, and include: Kneeland/Harrison, Kneeland/Surface Artery, Herald/Albany, and Herald/Frontage Road/Broadway Bridge.

Table 2-8
Existing (1989) Intersection Levels of Service
In New England Medical Center Study Area

<u>Location</u>	AM Peak Hour			PM Peak Hour		
	<u>LOS</u>	Average <u>Delay</u>	<u>V/C</u>	<u>LOS</u>	Average <u>Delay</u>	<u>V/C</u>
Stuart/Tremont	B	11 sec	0.71	B	12 sec	0.84
Kneeland/Washington	B	12 sec	0.64	B	9 sec	0.68
Kneeland/Harrison	B	15 sec	0.70	D	29 sec	0.97
Kneeland/Tyler	B	7 sec	0.54	B	10 sec	0.80
Kneeland/Hudson	B	10 sec	-	C	14 sec	-
Kneeland/Surf. Art.	C	16 sec	0.81	D	33 sec	1.01
Oak/Tremont	B	8 sec	0.27	B	8 sec	0.52
Oak/Washington	B	10 sec	0.51	B	11 sec	0.56
Oak/Harrison	A	3 sec	-	A	3 sec	-
Marginal/Arlington	B	7 sec	0.25	B	9 sec	0.46
Marginal/Tremont	B	10 sec	0.59	B	11 sec	0.69
Marginal/Shawmut	B	9 sec	0.38	B	11 sec	0.61
Marginal/Washington	A	3 sec	0.37	B	5 sec	0.36
Marginal/Harrison	A	4 sec	0.13	A	3 sec	0.28
Herald/Tremont	B	11 sec	0.52	B	10 sec	0.47
Herald/Shawmut	B	10 sec	0.40	B	12 sec	0.65
Herald/Washington	B	10 sec	0.60	B	10 sec	0.61
Herald/Harrison	B	10 sec	0.59	B	12 sec	0.79
Herald/Albany	B	14 sec	0.69	D	27 sec	0.99
Herald/Frontage & Broadway	F	78 sec	1.22	D	39 sec	1.10
E.Berkeley/Tremont	C	15 sec	0.82	B	13 sec	0.58
E.Berkeley/Shawmut	B	6 sec	0.41	B	9 sec	0.39
E.Berkeley/Washington	B	8 sec	0.50	B	9 sec	0.39
E.Berkeley/Harrison	B	10 sec	0.67	B	10 sec	0.49
E.Berkeley/Albany	B	14 sec	0.75	B	14 sec	0.72
E.Berkeley/Frontage & W. 4th	F	72 sec	1.20	B	12 sec	0.83

OS D is considered an acceptable traffic operating condition in urban areas, although it represents a good indicator of locations where additional traffic might cause traffic operational deficiencies.

2.7 Parking Conditions

Off Street Parking Supply

Existing off-street parking supply within the Medical Area is shown in Figure 2-6 and Table 2-9. As shown, total off-street parking supply is 2,888 spaces, of which 1,805 spaces in six lots and garages are reserved for NEMC patients, employees, and visitors. Of these, the 930 space Tremont Street Garage is open to the public from 5:00 PM to 7:00 AM, serving the theater district for evening performances and overnight parking needs in the area. Of the remaining 1,083 spaces, 651 spaces (60%) are open to the public, and 432 spaces (40%) are private. Parking is generally well occupied throughout the day, with the peak hour for the NEMC facilities occurring at around 1:00 PM. About 2,600 parkers use the NEMC facilities during an average weekday, as shown below:

<u>Type of Parker</u>	<u>Number</u>	<u>Percent</u>
Monthlies (staff)	497	19%
Other employees	1,032	39%
Students	149	6%
Patients/visitors	954	36%

As shown, medical center staff account for almost 60% of total parkers, and patients and visitors 36%. Students account for a modest 6% of total daily parking activity.

Parking patterns for the various types of users are described in more detail below.

NEMC Patient/Visitor Parking

Two facilities -- the Harrison Avenue Lot and the Tremont Street Garage -- are primarily used for NEMC patient/visitor parking, each of which also provides some monthly employee parking (see below). Harrison Avenue serves an average of around 400 patients and visitors per day in addition to around 50 monthly parkers. The Tremont Street Garage serves about 550 patients and visitors per day, in addition to 800 employees.

Table 2.9
Off-Street Parking In Study Area

<u>Facility Name</u>	<u>Total Spaces</u>	<u>NEMC Spaces</u>	<u>Public Spaces</u>	<u>Private Spaces</u>	<u>Hours</u>	<u>Spaces Full at 1:00 PM</u>
1. Tremont Street Garage	930	930 (days)	930 *	0	24 hours/day, 7 days/wk	930
2. Herald Street Garage	400	400	0	0	6am-1am M-F	400 +
3. Beach Street Garage	490	150	340	0	24 hours/day, 7 days/wk	200 - NEMC 100 - other
4. Oak Street lot	72	72	0	0	5am-5:30pm, M-F	85
5. Harrison Avenue Lot	193	193	0	0	6:30am-11pm, M-Sat, 12-11PM Su.	180
6. Washington Street lot	60	60	0	0	1pm-12am, M-F	15
7. Ash Street lot	47	0	47	0	Unrestricted	47
8. Tai Tung Village lots						
Hudson at Tai Tung	44	0	0	44	Resident	43
Hudson at Harrison	57	0	0	57	Resident	40
9. Chinese YMCA lot	25	0	0	25	Member	19
10. Carlos Park and Go	20	0	0	20	7am-4pm, M-Sat.	18
11. Teradyne lot	93	0	0	93		57
12. Pine Street lot	20	0	0	20	(South Cove)	8
	18	0	0	18	(Teradyne)	6
13. Fitz Inn/Pay Rate lot	89	0	89	0	7am-12am, M-Sat, 12-8 pm Sun	89
14. Back Bay Auto Parks	95	0	95	0	8am-12am, 7 days	95
15. Tremont House lot	35	0	0	35	Valet	35
16. Tremont Auto Parks	80	0	80	0	8am-12am M-Sat, Noon-12am Sun.	80
17. Quincy School gar.	28	0	0	28	School hours	20
18. Mass Pike Tower lot	92	0	0	92	Resident	46
Total	2888	1805	651	432		2513

* 930 spaces in Tremont St. Garage are open to the public from 5:00 PM to 7:00 AM to serve theater district, etc.

The parking rate structure for patients and visitors with validated tickets is the same at both facilities, namely :

-	Half hour:	\$1.50
-	One hour:	\$2.50
-	One and 1/2 hours:	\$3.25
-	Two hours:	\$4.00
-	Each additional 1/2 hour:	\$0.50
-	Maximum (24 hours):	\$7.00

A rate of \$12 per day is charged for those who do not obtain NEMC patient/visitor validation. This high rate is directed at prohibiting those who are not affiliated with NEMC from parking in the facilities.

NEMC Employee and Student Parking

NEMC employees and students are assigned various types of parking stickers which allow parking at specific facilities, as follows.

- First, around 600 monthly employee passes are issued, as follows:

-	Harrison Avenue lot (\$85/month)--	56 passes
-	Herald Street Garage (\$60/month) --	24 passes
-	Tremont Street Garage (\$105/month) --	307 passes
-	Oak Street Lot -- (\$75/month)--	35 passes
-	Beach Street Garage (\$60/month)--	177 passes

On an average day, there are about 500 monthly parkers actually present at these facilities, or about 83% of the number of stickers issued. Priority at the Tremont Street Garage is assigned to "hands on" doctors, nurses and faculty members. The Tremont Street Garage also accommodates most of the second shift medical staff.

In addition, 2000 yellow "prime time" stickers are issued to other staff for parking at the other facilities on a "first come first served" basis. These allow parking at all facilities if spaces are available. These stickers enable parking for a cost of \$4.50 per day at Tremont Street, \$3.50 per day at Oak Street and \$3.00 per day at Herald Street.

About 800 maroon student stickers allow parking for \$2.50 per day only at Herald Street, if spaces are available. Of the 2,800 yellow and maroon stickers, about 1,181, or 42%, actually park in NEMC facilities on an average day, reflecting both the variable schedules of students and part-time staff, and also the fact that some parkers are turned away if no space is available.

Gray employee stickers allow parking for \$3.00 at the Herald Street garage or for \$4.50 at Tremont Street in the evening hours only. Weekend employee parking at Tremont Street is also available for \$1.00 with these stickers.

Finally, parking for second shift NEMC employees only is allowed at the Washington Street lot for \$3.50 per day. No stickers are used at this lot, because usage is controlled through the hours of operation. This lot is only open from 1:00 PM to 12:00 AM Monday through Friday.

Employees and students who arrived by auto were questioned about parking locations of the vehicle driver in the survey conducted for this study. The results are shown in Table 2-10, below.

Table 2-10
Employee and Student Parking Supply

<u>Employee/Student Parking Location</u>	<u>Number</u>	<u>Percent</u>
Tremont Street Garage	318	42.0%
Herald Street Garage	188	24.9
Oak Street lot	62	8.2
Harrison Avenue lot	62	8.2
40 Beach Street Garage	58	7.7
On-street	40	5.3
Washington Street lot	18	2.4
Other Garage/lot	10	1.3
Total Responses	756	100.0%

As shown, about two-thirds of the respondents parked at the Tremont Street or Herald Street garages. Forty two percent of the respondents parked in the Tremont Street Garage, followed by Herald Street, where 25% parked. Of the total, about 7% parked on-street or in other lots and garages in the area not controlled by NEMC. This number is down from a rate of 13% on-street or in non-NEMC facilities reported by Vanasse-Hangen in the 1986 survey.

Public Parking

Public parking rates at the various lots and garages vary from \$2 to \$6 for the first hour, and from \$7 to \$16 for all-day. The average first hourly rate is \$4.32 and the average all day rate is \$12.29. These rates are comparable with those charged elsewhere in the southern portion of downtown Boston.

On-Street Parking

On-street parking conditions are summarized in Tables 2-11 and 2-12 and Figure 2-7. As shown, there are a total of 456 legal on-street parking spaces in the study area. Of these, 131 spaces or 30% of the supply are restricted to resident parking only. Of the remaining 325 spaces, the following restrictions apply, as shown in Table 2-11, below:

Table 2-11
On-Street Parking Restrictions

<u>Type of Parking</u>	<u>Spaces</u>	<u>% of Total Supply</u>
- Metered parking:	209	46%
- Unrestricted parking:	30	6%
- Handicapped parking:	15	3%
- Metered, but No Parking from 7-9:30 AM and 4-6 PM:	61	13%
- Unrestricted, but No Parking from 7-9:30 AM and 4-6 PM:	10	2%
Total non-resident	325	70%
Resident Parking Only	131	30%
Total on-street spaces	456	100%

On-street parking spaces are summarized by type and location in Table 2-12.

2.8 Transit Service

The study area is well served by MBTA bus, rapid transit and commuter rail services, as shown in Figure 2-8. The most convenient station to the medical area is Tufts/New England Medical Center station on the Orange Line, with its entrance adjacent to the Floating Hospital on Washington Street. This station on the new Orange Line brought a station directly into the medical area, where none had existed before. Boylston Station on the Green Line is about 1/4 mile from the hospital, and the Chinatown station on the Orange Line is about 1,000 feet away. Washington Station serves the Red Line, and

Table 2-12
On-Street Parking in Study Area

<u>Street</u>	<u>Metered Pkg.</u>	<u>Un- restr. Pkg.</u>	<u>HP Pkg.</u>	<u>Metered but NP 7-9:30 AM & 4-6 PM</u>	<u>Unrestr. but NP 7-9:30 AM & 4-6PM</u>	<u>Resi- dent Pkg.</u>	<u>Total Non- Resident Pkg.</u>	<u>Total Resident Pkg.</u>	<u>Total Parking Spaces</u>
Kneeland St.	0	0	0	61	10	0	71	0	71
Harvard St.	0	8	0	0	0	8	8	8	16
Nassau St.	15	0	0	0	0	0	15	0	15
Tai-Tung St.	0	0	0	0	0	14	0	14	14
Oak St.	0	0	0	0	0	37	0	37	37
Johnny Ct. & Maple Place	0	0	0	0	0	13	0	13	13
Marginal Rd.	42	2	0	0	0	0	44	0	44
Tremont St.	43	2	4	0	0	0	49	0	49
Washington St.	50	16	2	0	0	0	67	0	67
Harrison Ave.	59	3	9	0	0	0	171	0	71
Tyler St.	0	0	0	0	0	45	0	45	45
Hudson St.	0	0	0	0	0	14	0	14	14
Total	209	30	15	61	10	131	325	131	456

South Station, within walking distance, serves commuter rail passengers. Commuter rail riders from the north can connect to the Orange Line at North Station for service to the study area. Local MBTA bus routes serving the study area include Routes 9 and 11 from South Boston, Route 43 from Roxbury, and Route 49 from the South End. Intercity buses stop at the Greyhound terminal at Arlington Street and St. James St. in the Back Bay and at the Trailways Terminal near South Station, both of which are within -- mile of the medical area.

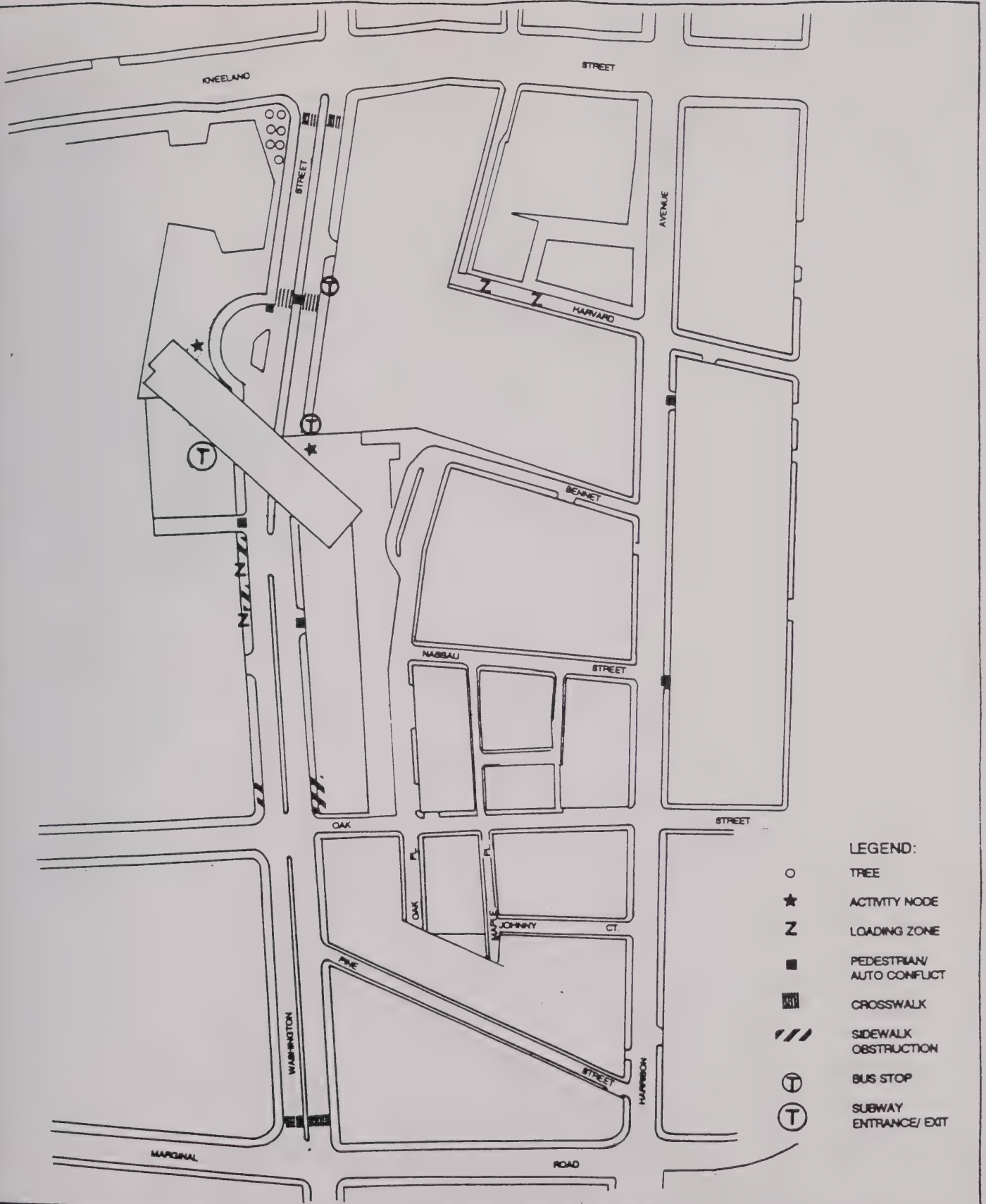
2.9 Pedestrian Conditions

To establish existing pedestrian conditions and flow patterns, surveys and counts were conducted during March, 1990 in the Washington Street and Harrison Avenue corridors from Kneeland Street to Marginal Road, and in the vicinity of the Herald Street garage. Pedestrian conditions are summarized in Figure 2-9. Count summaries are included in Figures 2.10 and 2.11. Detailed pedestrian count summaries are included in Appendix E. As shown, the heaviest peak hour volumes, both morning and evening, occur in the vicinity of the MBTA station entrance on Washington Street, and in the block which extends from Oak Street to Kneeland Street. The heaviest station moves occur in the crossing of Washington Street at the entrance, with 664 pedestrians leaving the station in this direction in the morning and 287 entering from this direction in the evening. Other crossing and midblock volumes fall into the "low to moderate" range as defined by the Institute of Transportation Engineers, with "low" volumes defined as under 200 pedestrians per hour, moderate as 200-400, and high, 600 and over.⁴

The general condition of sidewalks on both Washington Street and Harrison Avenue is good. Sidewalks adequately accommodate the existing volumes of pedestrians making pedestrian/pedestrian conflicts nonexistent. Obstacles on the sidewalks are few, with most impediments consisting of small broken patches of sidewalk.

The condition of sidewalks on side streets is less favorable. For example, Pine Street has a dirt sidewalk on the south side and a narrow two foot sidewalk on the north side. Pedestrians often use the street instead of the sidewalks. Foot and car traffic on Pine Street is minimal, so that the situation of pedestrian and autos sharing the street does not present an obvious conflict in this instance.

4. This definition applies to analysis of conflicting pedestrian movements in conducting intersection traffic capacity analysis, as outlined in the Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, D.C., 1985. Analysis of actual pedestrian facility capacity is a function of the relationships of the pedestrian volumes to effective walkway width, once obstructions are taken into account.



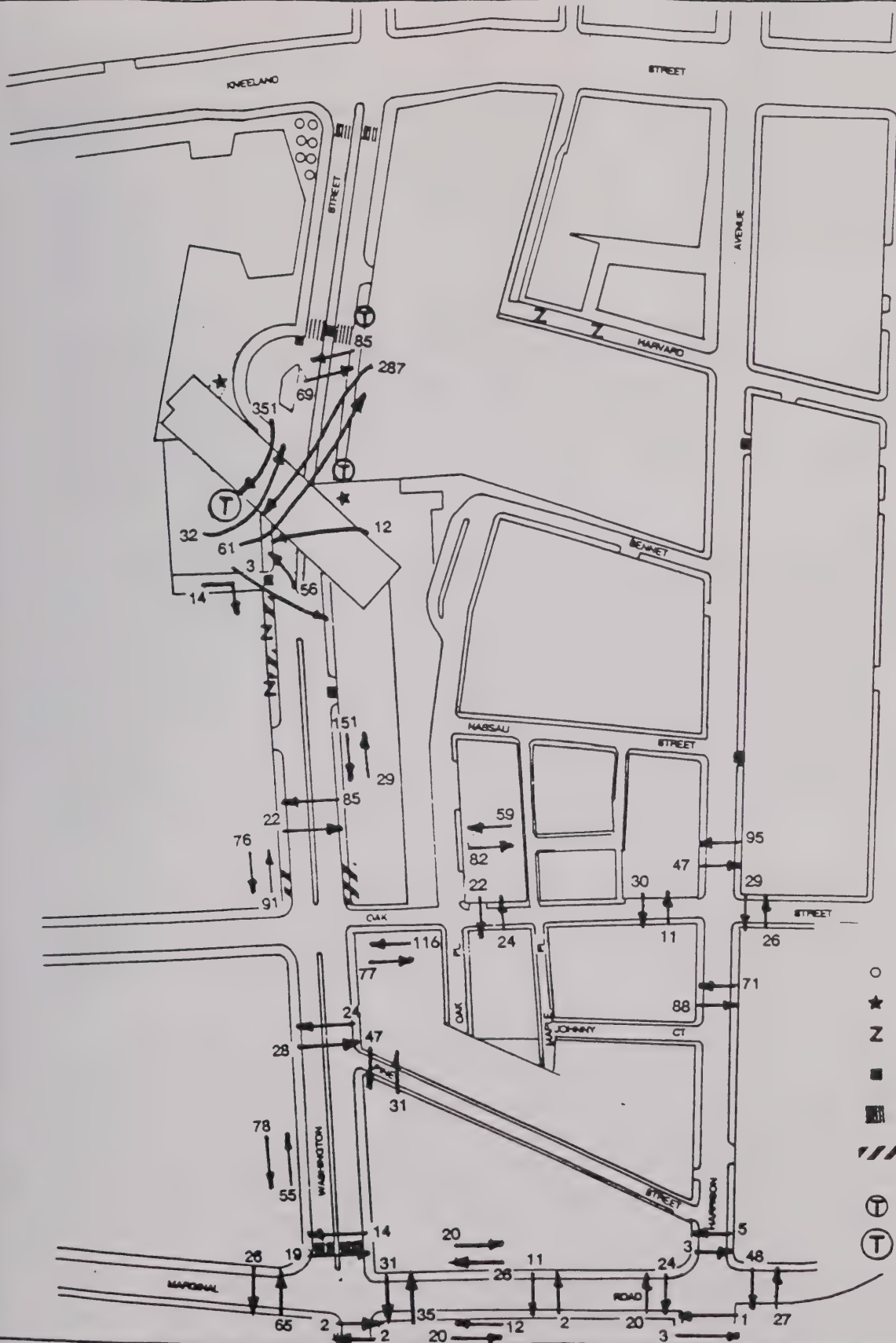


PEDESTRIAN VOLUMES: PEAK HOUR 8-9 AM

NEW ENGLAND MEDICAL CENTER AREA

N

Figure 2.10



PEDESTRIAN VOLUMES: PEAK HOUR 4-5 PM

NEW ENGLAND MEDICAL CENTER AREA

N

Figure 2.11

Washington Street from Kneeland Street to Marginal Road

On this section of the Washington Street corridor, pedestrian volumes are moderate while traffic volumes are heavy. There is presently no construction activity in this area. Sidewalks are generally in good condition and of adequate width to accommodate the existing volume of pedestrians.

Most pedestrian activity is concentrated at the entrances to NEMC and Tufts Medical buildings. Specifically, the entrance to the Floating Hospital and auto pick-up/drop-off area on the east side and the midblock hospital entrance on the west side are activity centers for pedestrians. Pedestrians cross the street at this location at a crosswalk that cuts through the median strip. There is a pedestrian signal at this location, although all pedestrians do not wait for the light. This path is parallel to the hospital's overhead walkway.

Transit stops and stations are also activity nodes for pedestrians. The New England Medical Center/South Cove subway stop on the Orange Line is located on the west side of the street between the Tremont Street Garage exit and the Floating Hospital entrance. In the morning peak period (7:00 - 9:00 AM), 1,831 people entered or exited the station. In evening peak period (4:00 - 6:00 PM), 528 people entered or exited the station. The large majority of these people who cross Washington Street cross at the crosswalk underneath the hospital's walkway. Bus stops on the east side of the street are congregating points for pedestrians. Bus stops are located in front of 710 Washington street and midblock under the hospital walkway. MBTA bus #11 (City Point to Downtown via Bayview Route) and #49 (Dudley Square to Downtown) stop at these locations.

The only sidewalk obstruction of note is the elevated sidewalk in front of the old Don Bosco building on the northeast corner of Washington and Oak Streets. At this location, a pedestrian must either walk up the elevated portion, walk on a narrow strip of sidewalk between the elevated sidewalk and parked cars, or go out into the street.

Pedestrian crossings are marked by crosswalks and breaks in the median strip in the area of the overhead walkway, in the area of 710 Washington Street and at the corner of Washington and Kneeland. The raised nature of the median strip does not allow pedestrians to stand on it or cross over it. However, a pedestrian/auto conflict exists at the entrance to the drop-off/pick-up area outside the Floating Hospital. There is a break in the median for cars at this point. Pedestrians also cross the street at this break, competing for the same space with cars.

A midblock pedestrian/auto conflict exists north of Oak Street near Commons Street. From 7AM-9AM, 202 people cross Washington Street at this point, while 212 people cross at this point from 4PM-6PM. In addition to these numbers of midblock crossing pedestrians, traffic volumes would most likely be at their highest during these peak commuting hours, making the conflict more severe.

Harrison Avenue from Kneeland Street to Marginal Road

Pedestrian volumes are light, as are traffic volumes on this corridor. For this reason, there are no pedestrian/pedestrian or pedestrian/auto conflicts that are apparent. Also, there is no construction activity affecting the street or sidewalks. No significant sidewalk obstructions exist at the present time.

The Posner parking lot, located at 172 Harrison Avenue, is an activity node for pedestrians walking to and from their parked cars. Other pedestrian activity is scattered among the various building entrances on the street.

Herald Street Garage

Pedestrians walking from the Herald Street garage have to cross over the Washington Street or Tremont Street bridges (over the Massachusetts Turnpike). However, most people who park there do not walk, but take the frequent shuttle bus to NEMC. Currently, two vans run in a loop to and from the garage and Floating Hospital on Washington Street from 6AM to 9AM and from 3PM to 1AM. The round trip takes about 10 minutes; the vans thus arrive about every five minutes. The route is shown in Figure 2.6, above.

Don Bosco High School

The 608 Don Bosco High School students take school buses which are parked along Oak Street, as well as using the MBTA Orange Line and bus routes which stop at the corner of Oak and Washington. They also cross Washington Street to access stores and restaurants during midday and after school periods.

Quincy School

Of concern with respect to the location of driveways for the Parcel A and B housing development are pedestrian patterns related to the Quincy School on Washington Street and to the many activities of the Quincy School Community Council. To determine school pedestrian activity and issues, an interview was conducted with Donna Cataldo of the school in March, 1990. The following information is based on this interview and subsequent conversations with others in the community.

The school has entrances at Oak and Washington Streets, used by about 15% of students, Shawmut Avenue and Marginal Street, used by 70% of students, and Marginal and Washington Streets (a handicapped accessible entrance) used by 15% of students. Approximately 700 students arrive each day between 8:15 AM and 8:30 AM, during the morn-

ing peak traffic hour (7:45 to 8:45 AM). About two-thirds of the students arrive by buses, mini-buses and vans, some are picked up and dropped off by parents in cars, and the remainder walk.

The remaining school activity occurs outside the traffic peak periods. Approximately 75-100 half-time kindergarten students leave the building at 11:30 AM and the same number of afternoon kindergartners arrive at 12:15 PM. Approximately 700 students leave the building at 2:15 PM.

The vans, mini-buses and buses use the Washington Street side of the building to pick up and discharge passengers. Large buses use the other sides of the building to load or unload. At dismissal, buses are parked along three sides of the building.

After 2:30 PM the only entrance open is at Oak and Washington Streets. During afternoons, the building is used by an afterschool program attended by 132 students, with 107 coming directly from classes in the building, and 25 walking to the school from bus stops. In addition, the building is used until 9:00 PM for community school, adult education, and recreation programs. The Quincy School Community Council is the largest social service provider in Chinatown, and pedestrian traffic at the intersection of Oak and Washington, is the busiest outside of the core business section of Chinatown. The South Cove Community Health Center, which serves 300-400 patients per day and employs 90 staff, the Quincy School Community Council's many human services programs for children and adults, the Golden Age Center's elderly programs such as the hot lunch program, and the Quincy Towers' elderly residents travelling to and from Chinatown shops on Beach Street all contribute pedestrian traffic.

add #s

3.0 FUTURE TRIP GENERATION

3.1 Target Year and Relationship to Other Development

This transportation study has been designed to meet several requirements:

- As a primary objective, it must describe the traffic and transportation impacts associated with NEMC Phase 1-C development to satisfy the MEPA requirements for an Environmental Impact Report.
- It must also provide an overview of traffic impacts associated with the New England Medical Center Master Plan, to satisfy the requirements of the Boston Redevelopment Authority.
- Finally, by agreement with BRA and the community, it must specifically look at traffic and circulation impacts of the Parcel A, B and C development projects.

To best meet these various requirements, the design year for analysis purposes was designated the Year 2000, which represents the ten year time frame which is reflected in the Master Plan. The No Build scenario thus includes background traffic projections for this ten year period. For NEMC development, the analysis is based on full build-out of Phase 1 development, which is the only phase which is expected to be implemented by the design year. This is desirable to meet the MEPA requirements for the Phase 1-C DEIR. In addition, Parcels A, B and C are expected to be implemented within this ten year horizon. However, to give the desired indication of how Phase 1 relates to the impacts of development associated with buildout of the entire Master Plan, however, we have also estimated traffic volumes for Phases 2 and 3 and the Research Building in spreadsheet tables which are included in the Technical Appendix to this report. However, since these developments will likely occur beyond the time frame of the Phase 1-C EIR, and since they represent replacements for existing buildings, we have not specifically included these volumes in the target year traffic analyses. Because they are replacement facilities, the traffic to be generated by the new buildings is essentially accounted for in the existing traffic volumes actually counted on the roadway network.

3.2 Future Year Analysis Assumptions/Methodology

To compare the transportation impacts of the No Build option, the NEMC Phase 1-C developments and the housing developments, the standard steps of the transportation planning process -- trip generation, mode split, trip distribution and network assignment -- were applied to the development parameters for each option, as discussed below.

Trip Generation Rates

Basic to a determination of development project transportation impacts is the estimation of the trips which the project will generate in various time periods of interest and for various travel modes. In this case, trip generation is examined for the AM and PM peak period, and for average weekday travel (AWDT).

As the basis for trip generation in this report, the Institute of Transportation Engineers (ITE) Trip Generation Manual, 1987 edition, was used. It is one of the major references used in the estimation of trip generation which presents trip generation rates for a wide variety of land uses based on surveys of actual developments located at various sites across the country.

The rates in the Manual deal with vehicle trips only, and in dominantly suburban settings where transit service is negligible. There is also no overt consideration of car occupancy as a variable factor, nor any division between journey to/from work and other trips. In order to apply these rates to central Boston where transit and walk-in trips play substantial access roles, the Manual vehicle trip rates had to be converted to person trip rates. The person trips had to be then broken down into the various travel modes (automobile, transit, walking) and work/non-work categories. Vehicle trips were obtained by dividing auto person trips by appropriate car occupancy factors.

In this report, person trips were obtained from the ITE vehicle rates by conversion factors related to ITE probable car occupancies and an allowance for some nominal transit and walk access.¹ The resultant person trip rates for each activity and time period were also compared for compatibility with person trip rates used in other Boston transportation analyses. Trip estimation had to be done for each land use component for each development option considered.

The Boston trip generation sources referred to were Central Transportation Planning Staff (CTPS) interim trip generation rates related to the Central Artery project, the 1989 Access Plan Guidelines of the Boston Transportation Department (BTD), and a number of EIR's for previous Downtown Boston developments. These were referenced for consistency checks and used for the estimation of the division between work and non-work trips. The person trip rates adopted are presented in Table 3.1 for each land use by

1. ITE car occupancies differ by land use and trip purpose (i.e. work/nonwork). For example, for office work trips, ITE car occupancy reflected in the vehicle trip rates in the Trip Generation manual is assumed to be 1.2, with very little transit use. To convert these vehicle rates into person trips, the initial number of trips is multiplied by 1.2, then by an additional 10% to account for possible transit or walk trips not reflected in the ITE rates. The result is a conservative 1.32 multiplier applied to the vehicle trip rates. This would be applied as follows: To convert 100 vehicle trips to person trips, multiply the trips by 1.32. The resulting person trips would be 132.

Table 3.1 - Person Trip Generation Rates

HOSPITAL			RESEARCH			HOUSING			RECREATION			HOTEL			RETAIL			DAY CARE		
(1,000 sf)			(1,000 sf)			(unit)			(1,000 sf)			(room)			(1,000 sf)			(1,000 sf)		
Adj. Factors:			Adj. Factors:			Adj. Factors:			Adj. Factors:			Adj. Factors:			Adj. Factors:			Adj. Factors:		
Transit -	na	na	Transit -	6.0%	na	Transit -	9.0%	na	Transit -	na	0.0%	Transit -	na	na	Transit -	na	na	Transit -	na	na
V. Occ. -	na	na	V. Occ. -	1.2	na	V. Occ. -	1.8	na	V. Occ. -	na	1.6	V. Occ. -	na	na	V. Occ. -	na	na	V. Occ. -	na	na
Source: BTD/CTPS			Source: ITE #760			Source: ITE #222			Source: BTD/CTPS			Source: ITE #320			Source: BTD/CTPS			Source: BTD/CTPS		
Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate		Unadj. Rate	Person Trip Rate	
6.80	6.80		4.58	5.85		2.16	4.27		0.84	0.84		1.29	2.06		4.50	4.50		3.56	3.56	
9.20	9.20		2.46	3.14		3.24	6.41		83.36	83.36		7.32	11.71		32.90	32.90		114.84	114.84	
16.00	16.00		7.04	8.99		5.40	10.68		84.20	84.20		8.61	13.78		37.40	37.40		118.40	118.40	
ADT -																				
AM PEAK HOUR -																				
IN:																				
work	0.80	0.80	0.82	1.05		0.05	0.10		0.11	0.11		0.05	0.08		0.18	0.18		0.39	0.39	
non-work	0.30	0.30	0.20	0.26		0.07	0.14		3.41	3.41		0.39	0.62		0.12	0.12		12.32	12.32	
total	1.10	1.10	1.02	1.30		0.12	0.24		3.52	3.52		0.44	0.70		0.30	0.30		12.71	12.71	
OUT:																				
work	0.20	0.20	0.00	0.00		0.14	0.28		0.00	0.00		0.02	0.03		0.00	0.00		0.00	0.00	
non-work	0.10	0.10	0.11	0.14		0.20	0.40		0.88	0.88		0.20	0.32		0.20	0.20		9.59	9.59	
total	0.30	0.30	0.11	0.14		0.34	0.67		0.88	0.88		0.22	0.35		0.20	0.20		9.59	9.59	
TOTAL:																				
work	1.00	1.00	0.82	1.05		0.19	0.38		0.11	0.11		0.07	0.11		0.18	0.18		0.39	0.39	
non-work	0.40	0.40	0.31	0.40		0.27	0.53		4.29	4.29		0.59	0.94		0.32	0.32		21.91	21.91	
total	1.40	1.40	1.13	1.44		0.46	0.91		4.40	4.40		0.66	1.06		0.50	0.50		22.30	22.30	
PM PEAK HOUR -																				
IN:																				
work	0.10	0.10	0.06	0.08		0.11	0.22		0.00	0.00		0.00	0.00		0.22	0.22		0.00	0.00	
non-work	0.20	0.20	0.11	0.14		0.16	0.32		2.08	2.08		0.35	0.56		0.87	0.87		10.37	10.37	
total	0.30	0.30	0.17	0.22		0.27	0.53		2.08	2.08		0.35	0.56		1.09	1.09		10.37	10.37	
OUT:																				
work	0.80	0.80	0.82	1.05		0.07	0.14		0.09	0.09		0.02	0.03		0.44	0.44		0.34	0.34	
non-work	0.50	0.50	0.14	0.18		0.11	0.22		3.03	3.03		0.28	0.45		1.77	1.77		10.89	10.89	
total	1.30	1.30	0.96	1.23		0.18	0.36		3.12	3.12		0.30	0.48		2.21	2.21		11.23	11.23	
TOTAL:																				
work	0.90	0.90	0.88	1.12		0.18	0.36		0.09	0.09		0.02	0.03		0.66	0.66		0.34	0.34	
non-work	0.70	0.70	0.25	0.32		0.27	0.53		5.11	5.11		0.63	1.01		2.64	2.64		21.26	21.26	
total	1.60	1.60	1.13	1.44		0.45	0.89		5.20	5.20		0.65	1.04		3.30	3.30		21.60	21.60	

analysis period, divided into work and non-work categories. (It may be noted that a "work" trip includes only the journeys to or from the place of employment. "Additional" trips made by employees, even on business, would be considered "non-work.")

Modal Split and Car Occupancy Calculations

As stated above, the determination of total person trip generation is followed by the assignment of the person trips for each land use to the appropriate mode of transportation; i.e., automobile, transit, or walk/other (taxi, bike, etc.). For the vehicle trips, auto person trips are converted to auto trips by vehicle occupancy factors, i.e., the number of persons per car for each type of trip.

Mode split and vehicle occupancy tend to vary between different land uses due to the specific trip making characteristics related to each. The distinction between various mode split and vehicle occupancy factors also applies to the type of trip being made, most commonly divided into work and non-work trips. For example, the mode split for hotel workers is similar to that for office workers or retail workers, but hotel guests will have very different patterns both from the hotel workers and from office visitors or retail customers. Mode split and vehicle occupancy is also heavily influenced by the location of the particular development, especially in terms of vehicular and transit accessibility and parking availability and price.

Table 3.2 presents the mode split and vehicle occupancy trip making characteristics by land use for work and non-work trips to the NEMC and Chinatown development sites as fairly typical Downtown Boston locations. These mode split and vehicle occupancy factors are derived from the NEMC employee surveys conducted by Howard/Stein-Hudson Associates, as described in Section 2.3 above and from environmental impact reports from recent nearby projects, as shown in the Table.

Trip Distribution

The basis for the trip distribution proportions was the origin/destination information gathered for workers from the NEMC employee survey, for visitors from the 1986 Vanasse Hangen visitor survey, and for residents, CTPS 1980 Journey to Work data, all as described above and set forth in Tables 2.3 to 2.7 for the different travel modes, and summarized below.

Table 3.2
NEMC/Chinatown Trip Characteristics

Mode Split:

<u>Land Use</u>	<u>Auto</u>	<u>Vehicle Occupancy</u>	<u>Transit</u>	<u>Walk/ Other</u>	<u>Source:</u>
Hospital:					
work	53.2%	1.2	43.8%	3.0%	H/SH Survey (1990)
non-work	60.0%	1.5	29.4%	10.6%	V/H Survey (1986)
Research:					
work	53.2%	1.2	43.8%	3.0%	H/SH Survey (1990)
non-work	27.5%	1.4	57.5%	15.0%	One Lincoln & Comm. Ctr. EIRs
Housing:					
work	33.0%	2.1	10.0%	57.0%	CTPS
non-work	28.0%	1.1	35.0%	37.0%	Parkside West Access Plan (adj.)
Recreation:					
work	30.0%	1.4	65.0%	5.0%	Comm. Ctr. EIRs
non-work	27.5%	1.4	32.5%	40.0%	Comm. Ctr. EIRs
Hotel:					
work	30.0%	1.4	60.0%	10.0%	One Lincoln EIRs
non-work	55.0%	1.9	20.0%	25.0%	One Lincoln EIRs
Retail:					
work	30.0%	1.4	60.0%	10.0%	One Lincoln & Comm. Ctr. EIR's
non-work	27.5%	1.9	32.5%	40.0%	One Lincoln & Comm. Ctr. EIR's
Day Care:					
work	30.0%	1.4	65.0%	5.0%	Comm. Ctr. EIRs
non-work	27.5%	2.3	32.5%	40.0%	Comm. Ctr. EIRs (adjusted)

Vehicle Trips: The future project traffic volumes for impact analyses of NEMC development and the proposed housing developments at key study area intersections were estimated by distributing the vehicle trips generated into the directions of origin/destination, and assigning this directional division of trips to the actual roadways serving the development. Trip distribution was calculated separately for each development, since access to and from the parking lots and garages differed given the one-way street patterns in the area. Similarly, distribution of trips was different for entering vs. exiting traffic. Existing street features were assumed in the trip distribution analysis. For example, no left turns were assumed into the Parcel A/B garage from Washington Street southbound, due to the presence of the median in Washington Street at the project driveway. Figures 3.1 through 3.6 summarize the vehicular trip distribution for the existing NEMC garages, (the Herald Street Garage and the Tremont Street Garage), and the proposed Chinatown housing developments. Once the traffic was assigned to the street system in accordance with these guidelines, the resulting volumes, when added to background growth traffic formed the future year traffic volume input for calculation of Levels-of-Service (LOS).

Public Transportation Trips: Public transportation trips were distributed to the various transit modes serving the site on the basis of station use reported in the NEMC survey, as shown in Table 2.4, above. The new NEMC Orange Line station accounts for 68% of all transit user activity, followed by Boylston Station with 13% then Downtown Crossing with 9%. About 5% of the transit riders walk from South Station.

Pedestrian Trips: Pedestrian trip distribution was based on an analysis of relative boardings at the transit stations within walking distance of the site, and likely midday pedestrian trips to and from the Downtown Crossing shopping district and Chinatown. It is anticipated that the primary entrance and exit for the 1-C North Building will be provided on Washington Street, and the entrance/exit for the Phase 1-C South Building on Ash Street, as shown in Figure 3-7. For each of these locations, primary pedestrian flows will occur on Washington Street between Nassau Street, the MBTA Station entrance, and Kneeland Street. Secondary flows will occur across Washington Street to the Tremont Street parking garage, along Nassau Street towards Harrison Avenue parking locations, and along Washington Street southbound.

3.3 No-Build Trip Estimation

As agreed in the Scope of Work for this project, the estimates of future traffic in the target year 2000 without the projects ("No-Build") being dealt with in this report were based upon the build traffic levels for the Boston Crossing project as found in its Environmental Impact Report. Since the Boston Crossing target year is 1995, it was necessary to use a method that would project No-Build traffic growth to the NEMC year of 2000.

A growth factor approach was selected based on the Boston Crossing traffic changes on Harrison Avenue and Washington Street as the streets lead directly into the Study Area at the common boundary of Kneeland Street. The existing counts at these locations are the same for Boston Crossing and this project, giving base volume consistency. The growth in this traffic for the Boston Crossing target year averaged 13% for the AM and PM peak hour, and this value was applied to both periods.

The future target year for Boston Crossing, 1995, is different than the target year of 2000 for this report. For this reason, an annual growth rate was calculated and applied to the longer period. One important adjustment was made, involving the Boston Crossing future year. Due to the fact that a number of projects covered in the Boston Crossing work have experienced longer approval and development financing processes than expected, and that there is also a general slowing of downtown development at the present time, the 1995 target year was changed by two years to 1997 for rate calculations. With this assumption, the annual (compound) growth rate amounts to 1.54%, yielding a total increase of 18% for the 1989 to 2000 period.

To complete the No-Build analysis, two additional No-Build increments were accounted for, namely the further development of the Tufts University Medical School and the Centennial Partners proposed mixed use development on Tremont Street. The Centennial Partners project was accounted for by distributing and adding the estimated vehicle trip generation to the access streets involved. The Tremont Street Garage trip distribution (as shown in Figures 3.3 and 3.4) was used as the basis for this assignment. Tufts development was accounted for by growth factor method. It was estimated that Tufts could add about an additional 250,000 SF by the year 2000 (subsequently stated as about 283,000 SF, but not different enough to warrant modification in the analyses). This 250,000 SF was compared to the inventory of floor space in the core study area (CTPS Zones 30A, 30B & 30C), and amounted to about 5%. Existing trips were factored upward by this additional 5%. No-build levels were therefore estimated at about 23% (18% + 5%) higher than existing plus the specific addition of the Centennial project. Year 2000 estimated No-build volumes for the AM and PM peak hours are shown in Figures 3.8 and 3.9.

3.4 Trip Generation of Projects

Utilizing the person trip generation rates, modal split, and car occupancies described above, the trip generation of the projects under study was estimated for an average weekday and the AM and PM peak hours by applying the rates and factors to the development programs involved. The resultant total person trips are shown in Table 3.3, with vehicle, transit, and walk trips being shown in Tables 3.4 to 3.6, respectively.

These trip generation results can be viewed in several different ways. To give a comparison of the relative importance of the three modes of travel analyzed, total two-way person trips are summarized by mode by analysis period in bar charts of Figure 3.10. Here the significant roles being played by transit and walking can be seen. Expressed as mode use percentages the person tripmaking is further summarized in the following table:

<u>Percentage of Trips by Indicated Mode</u>			
<u>Person Trip Mode</u>	<u>ADT</u>	<u>AM Peak Hour</u>	<u>PM Peak Hour</u>
Automobile	34.8%	37.8%	37.7%
Public Transit	32.6%	34.0%	33.7%
Walk Only	32.6%	28.1%	28.5%
Person Trips			
All Modes	13,836	1,002	1,097
	100%	100%	100%

As shown above, person trips by automobile account for only about one-third of all daily tripmaking to and from the study area for the various projects, and slightly more than one-third in the peak hours. Transit and walking account about equally for the remaining two-thirds of all person trips.

Table 3.3
Total Person Trip Generation

<u>Phase/Use</u>	<u>Size</u> (000 sf)	<u>ADT</u>	AM PEAK HOUR			<u>In</u>	PM PEAK HOUR	
			<u>In</u>	<u>Out</u>	<u>Total</u>		<u>Out</u>	<u>Total</u>
NEMC:								
Phase 1C-North -								
Hospital	121.03 sf	1,936	133	36	169	36	157	194
Research	50.00 sf	449	65	15	80	11	65	76
1C-N total	171.03 sf	2,386	198	51	250	47	222	269
Phase 1C-South -								
Hospital	50.94 sf	815	56	15	71	15	66	82
Research	30.00 sf	270	39	9	48	7	39	46
1C-S total	80.94 sf	1,085	95	24	119	22	105	127
Subtotal NEMC 1C	251.97 sf	3,470	293	76	369	69	328	397
Parcel A -								
Housing	141 du	1,506	33	95	128	75	50	126
Parcel B -								
Housing	120 du	1,282	28	81	109	64	43	107
Parcel C -								
Recreation	90.00 sf	7,578	317	79	396	187	281	468
Subtotal Chinatown	90.00 sf 261 du	10,366	379	255	633	327	374	700
Total Study Area	341.97 sf 261 du	13,836	672	330	1,002	396	701	1,097

Table 3.4
Vehicle Trip Generation

<u>Phase/Use</u>	<u>Size</u>	<u>ADT</u>	<u>AM PEAK HOUR</u>			<u>PM PEAK HOUR</u>		
			<u>In</u>	<u>Out</u>	<u>Total</u>	<u>In</u>	<u>Out</u>	<u>Total</u>
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	843	61	17	78	16	71	87
Research	50.00 sf	172	28	1	29	3	27	30
1C-N total	171.03 sf	1,016	89	18	107	19	98	117
Phase 1C-South -								
Hospital	50.94 sf	355	26	7	33	7	30	36
Research	30.00 sf	103	17	1	18	2	16	18
1C-S total	80.94 sf	458	43	8	50	8	46	55
Subtotal NEMC 1C	251.97 sf	1,474	132	26	157	27	144	171
Parcel A -								
Housing	141 du	325	7	20	27	16	11	27
Parcel B -								
Housing	120 du	276	6	17	23	14	9	23
Parcel C -								
Recreation	90.00 sf	1,490	62	16	78	37	55	92
Subtotal Chinatown	90.00 sf	2,091	76	53	129	67	75	142
261 du								
Total Study Area	341.97 sf 261 du	3,565	207	79	286	94	220	314

Table 3.5
Transit Person Trip Generation

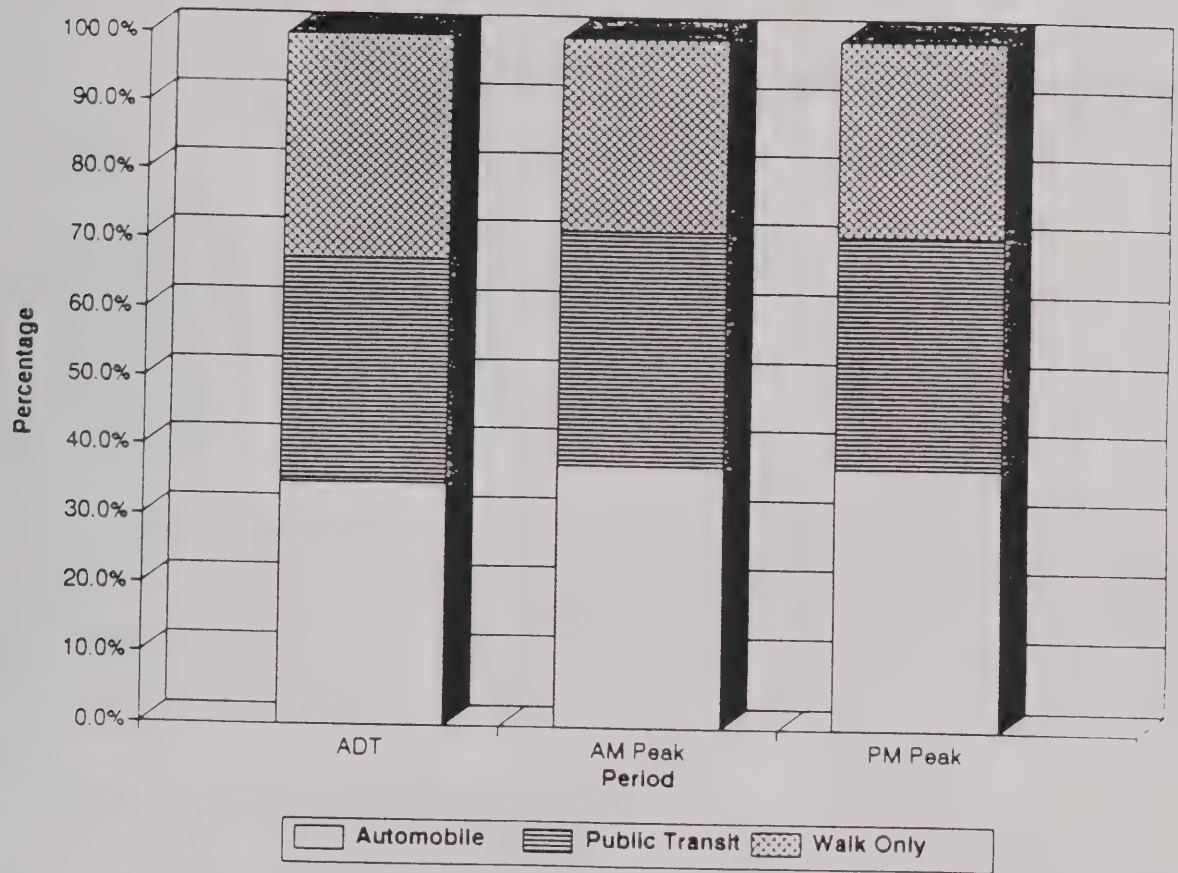
<u>Phase/Use</u>	<u>Size</u>	<u>ADT</u>	<u>AM PEAK HOUR</u>			<u>PM PEAK HOUR</u>		
			<u>In</u>	<u>Out</u>	<u>Total</u>	<u>In</u>	<u>Out</u>	<u>Total</u>
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	688	53	14	67	12	60	73
Research	50.00 sf	218	30	4	34	6	28	34
1C-N total	171.03 sf	906	83	18	102	18	88	106
Phase 1C-South -								
Hospital	50.94 sf	290	22	6	28	5	25	31
Research	30.00 sf	131	18	2	20	3	17	20
1C-S total	80.94 sf	421	41	8	48	9	42	51
Subtotal NEMC 1C	251.97 sf	1,327	124	26	150	27	130	157
Parcel A -								
Housing	141 du	377	8	23	31	19	13	32
Parcel B -								
Housing	120 du	320	7	20	27	16	11	27
Parcel C -								
Recreation	90.00 sf	2,487	106	26	132	61	94	155
Subtotal Chinatown	90.00 sf	3,184	121	69	190	95	117	213
	261 du							
Total Study Area	341.97 sf	4,511	245	96	341	122	248	370
	261 du							

Table 3.6
Walk Trip Generation

Phase/Use	Size	ADT	AM PEAK HOUR			PM PEAK HOUR		
			In	Out	Total	In	Out	Total
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	143	7	2	9	3	9	12
Research	50.00 sf	32	3	1	4	1	3	4
1C-N total	171.03 sf	175	10	3	13	4	12	16
Phase 1C-South -								
Hospital	50.94 sf	60	3	1	4	1	4	5
Research	30.00 sf	19	2	1	3	1	2	3
1C-S total	80.94 sf	79	5	2	7	2	6	8
Subtotal NEMC 1C	251.97 sf	255	15	5	20	6	18	24
Parcel A -								
Housing	141 du	678	15	43	58	34	22	56
Parcel B -								
Housing	120 du	577	13	37	50	29	19	48
Parcel C -								
Recreation	90.00 sf	3,005	123	32	155	75	109	184
Subtotal Chinatown	90.00 sf	4,259	151	111	262	138	151	289
	261 du							
Total Study Area	341.97 sf	4,514	167	116	282	144	169	313
	261 du							

Figure 3.10

Percentage of Person Trips by Mode



Since the impact of automobiles is of prime importance in the impact analyses, the relative contribution of Build condition vehicle trips from the component projects is set forth in the bar charts of Figure 3.11. This allows an overview of the trip generation share of each project in total auto impacts which can be attributed to the projects being analyzed. The percentage contributions are shown as follows:

<u>Build Project</u>	<u>Proportion of Vehicle Trips Generated by Component Project:</u>					
	<u>ADT</u>		<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Trips</u>	<u>%</u>	<u>Trips</u>	<u>%</u>	<u>Trips</u>	<u>%</u>
NEMC Phase 1-C	1,474	41.3	157	55.1	171	54.5
Parcel A - CEDC Housing	325	9.2	27	9.5	27	8.7
Parcel B - ACDC Housing	276	7.7	23	8.1	23	7.4
Parcel C - Recreation Ctr.	1,490	41.8	78	27.4	92	29.4
Total Build Projects	3,565		285		313	

The effect of differences in the concentrations of travel during peak hours among the several projects can be seen. Although the largest peak hour contributor is the NEMC 1-C project, the ADT trip contribution is only 41%. The daily travel of the Recreation Center is most striking at 41.8%. It is of course the peak hour traffic which is of greatest concern in judging transportation impacts.

3.5 Assignment of Trips to Streets and Transit

Streets - The vehicle trips generated were assigned to the roadway network according to the patterns of regional trip distribution described under Existing Conditions above. The assignment of Build NEMC trips was centered on the Herald Street Garage, the expansion of which is envisioned as the destination for net increases in NEMC tripmaking. For the housing and the Recreation Center, trips were centered on the assumed parking entrance(s) at each site. As an example of the street routings chosen in the assignment process, Figures 3.1 and 3.2, above, show the patterns for entering and exiting vehicles using the Herald Street Garage. The assigned project trips were added to the No-Build volumes to yield the AM and PM Peak Hour Build volumes shown for the Study Area in Figures 3.12 and 3.13, respectively.

Transit - Transit (person) trip generation was also distributed to the transit system according to the distribution pattern described above, based on the assumption that the regional tripmaking patterns would not change significantly over the analysis period to year 2000. The results of this assignment process for the various transit lines and other carriers is shown in Table 3.7. The largest transit service to study projects is afforded by NEMC Station on the Orange Line, followed by the Green Line (Boylston) and the Red Line (Downtown Crossing or South Station).

Figure 3.11

Proportion of Vehicle Trips Generated by Component Project

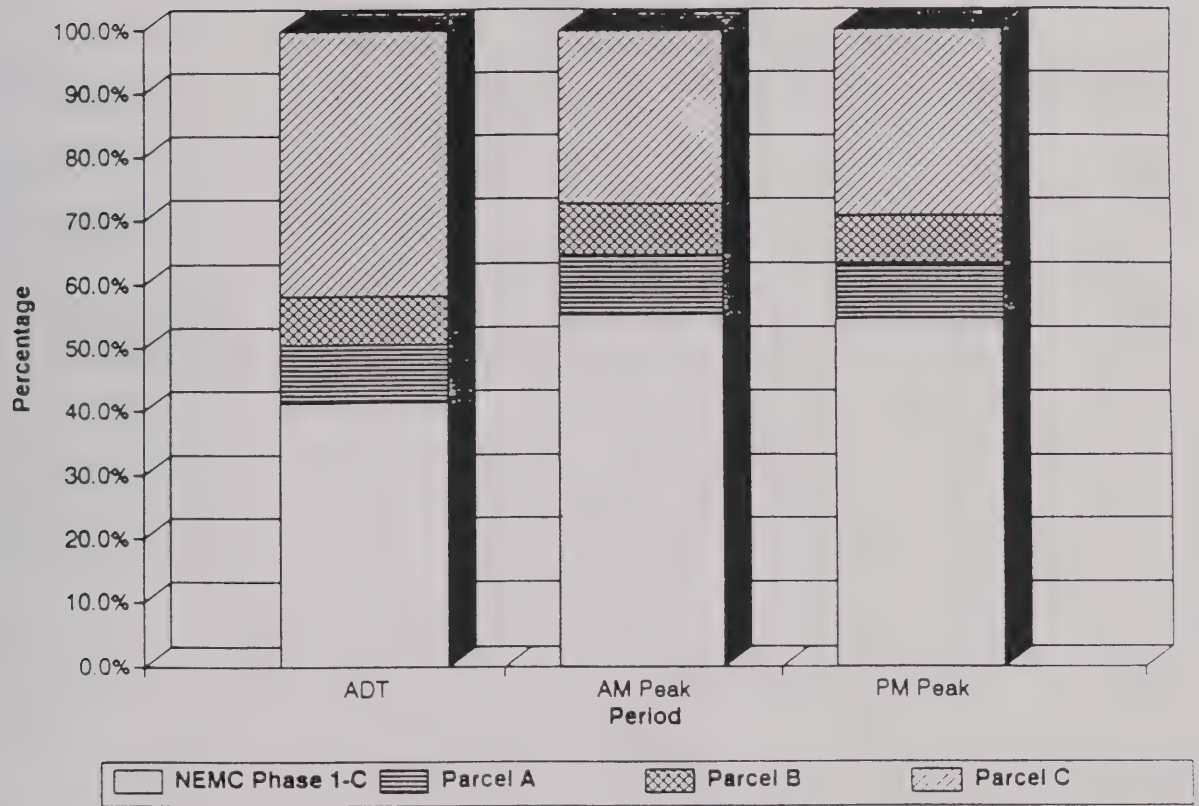


Table 3-7

Added Transit Trips by Station
for NEMC and Other Study Area Projects: Year 2000

<u>Use/Time Period</u>	<u>Total Transit Trips</u>	<u>Trips by Station:</u>					
		<u>NEMC</u>	<u>China- town</u>	<u>South Station</u>	<u>Downtown Crossing</u>	<u>Park</u>	<u>Boylston</u>
% Usage:		69%	1%	5%	9%	3%	13%
NEMC Phase 1-C							
Daily	1327	916	13	66	119	40	173
AM Peak (inbound)	124	86	1	6	11	4	16
PM Peak (outbound)	130	90	1	7	12	4	17
Parcel A							
Daily	377	260	4	19	34	11	49
AM Peak (inbound)	23	16	0	1	2	1	3
PM Peak (outbound)	19	13	0	1	2	1	2
Parcel B							
Daily	320	221	3	16	29	10	42
AM Peak (inbound)	20	14	0	1	2	1	3
PM Peak (outbound)	16	11	0	1	1	0	2
Parcel C							
Daily	2487	1716	25	124	224	75	323
AM Peak (inbound)	106	73	1	5	10	3	14
PM Peak (outbound)	94	65	1	5	8	3	12

Table 3-8
NEMC/Chinatown Housing Parking Demand

	Work:		Nonwork:		Residential:			
	Round	Work	Round	Turnover	Number of	Cars per	Nonwork	Total
	<u>Trips</u>	<u>Parking</u>	<u>Trips</u>	<u>Rate</u>	<u>D.U.</u>	<u>D.U.</u>	<u>Parking</u>	<u>Parking</u>
	<u>(veh)</u>	<u>Demand</u>	<u>(Veh)</u>				<u>Demand</u>	<u>Demand</u>
NEMC Phase 1-C								
Hospital	179	125	242	4.00	0	0	61	186
Research	56	39	30	4.00	0	0	7	47
Total	235	165	272				68	233
Parcel A Housing	na	0	na	na	141	0.35	39	39
Parcel B Housing	na	0	na	na	120	0.35	34	34
Parcel C Recreation	7	7	738	3.00	0	0	246	253
Total	242	172	1010		261		387	559

Work/Non Work Breakdown (Percent of Total Daily Round Trips):

	Work	Nonwork	
	<u>%</u>	<u>%</u>	<u>Comments</u>
Hospital	42.5	57.5	70% attendance factor
Research	65.0	35.0	70% attendance factor
Housing	40.0	60.0	80% of resident cars left parked during the day
Recreation	1.0	99.0	
Hotel	15.0	85.0	
Retail	12.0	88.0	
Day Care	3.0	97.0	

Source: Table 3.1 (Person Trip Generation Rates)

4.0 IMPACT ANALYSES

4.1 Assumptions

The scope for this study requires a certain condition of No-Build traffic growth without specification of the related transportation system. On the other hand, analyses of the Build condition require evaluation of several system alternatives, e.g., with and without the Central Artery/Third Harbor Crossing (CA/T) project and with and without certain proposed changes in nearby Turnpike ramps. All this could lead to a confusing array of combinations of No-Build and Build analyses under different network conditions.

To provide a clear structure for this process, both the No-Build and Build analyses were done on the existing network as a base case. This base case was then evaluated for the effects that the other system alternatives would have, particularly on problem location. This allows a clear perspective on the effects that system changes will have on future access demand conditions.

On the issues of CA/T project and Turnpike ramp alternatives, it must be stressed at the outset that the number and combination of ramp layouts in and around the Study Area of this report are manifold and under the process of review and/or design. The determination and assessment of impacts and possible mitigation are the responsibility of the CA/T project and the Turnpike Authority, who are engaged in a continuing project development process. Analyses are ongoing and much work has, and is being done subsequent to the work done in this report. This study, of course, has its own context and focus. Within this, the CA/T and Turnpike ramp evaluation has validity, but differences and limitations with respect to the CA/T process must be acknowledged and kept in mind. An overview/retrospect section will be presented later with the Roadway Alternatives analyses to help guide the reader in this regard.

CA/T Project. This major undertaking involves the depression and widening of the Central Artery from Massachusetts Avenue to Charlestown plus the construction of a new Harbor tunnel as an extension of the Turnpike, routed through South Boston industrial land to Logan Airport in East Boston and beyond. This project entails of course the creation of new and the modification of old ramp connections. The purpose of the project is to give better service to growing major regional traffic flows while relieving local streets of significant arterial volumes. The hope for the Study Area is that certain types of traffic which now uses local streets to bypass Central Artery congestion will remain on the much improved regional system. One major feature of the CA/T affecting the Study Area is the creation of a southbound off-ramp leading into Marginal Road (with a branch also connecting to the Turnpike). Major traffic volumes using this connection could offset the intent of the Turnpike ramp changes noted below.

Turnpike Ramp Changes. In an effort to divert some traffic on local streets to the Turnpike while giving more immediate access to the regional system from the South End, Chinatown and Back Bay, and Back Bay, Turnpike ramp changes have been proposed. The most extensive changes would involve the creation of both an outbound off-ramp at Berkeley Street and an inbound on-ramp at Tremont Street, fed by an extension of Herald Street from Tremont west to Clarendon Street. The existing Arlington Street outbound ramp would have to be eliminated to allow the outbound off-ramp to Berkeley.

The effects of the proposed changes on Marginal Road and to a lesser extent on Herald Street are of greater local interest in the Study Area, as Marginal Road is immediately adjacent to Chinatown residential and school areas. As consideration of the total ramp changes evolved, the inbound ramp from Tremont Street with the Herald Street extension have been eliminated from planning due to physical feasibility (passage over railroad tracks, etc.) and funding restraints. Only the outbound ramp proposal to Berkeley Street is now being considered, and it is this alternative which is being evaluated in this report. The expectations here would be in the reduction of westbound traffic only on local streets, notably Marginal Road. This ramp proposal is being (comprehensively) assessed by the Turnpike Authority in an Environmental Impact Report.

4.2 Year 2000 No-Build Impacts - Base Case Vehicular

Levels-of Service (LOS) analyses were performed for the AM and PM peak hour for the (year 2000) No-Build traffic volumes described under Future Trip Generation and shown in Figures 3.8 and 3.9, above. As noted above, these were performed under existing roadway conditions as the base case. The results of this analysis work are shown in Table 4.1.

It can be seen that six intersections operate at unacceptable LOS (less than LOS D) during either or both peak hours, four more than under existing (1989) conditions. The unacceptable locations are:

	<u>Intersection</u>	<u>Peak Hour</u>	<u>1989 LOS</u>	<u>2000 No-Build LOS</u>
1.	Stuart/Tremont	AM	B	E
	"	PM	B	F
2.	Kneeland/Harrison	PM	D	F
3.	Kneeland/Surface Artery	PM	D	F
4.	Herald/Albany	PM	D	F
5.	Herald/Frontage/ Broadway Bridge	AM	F	F
	"	PM	D	F
6.	E. Berkeley/Frontage/ W. Fourth	AM	F	F

Table 4.1
No-Build Level of Service (LOS) Analysis Summary

<u>Location</u>	AM Peak Hour			PM Peak Hour		
	<u>LOS</u>	<u>Average Delay</u>	<u>V/C</u>	<u>LOS</u>	<u>Average Delay</u>	<u>V/C</u>
Stuart/Tremont	E	57 sec	1.21	F	531 sec	1.87
Kneeland/Washington	C	19 sec	1.00	D	35 sec	1.17
Kneeland/Harrison	C	19 sec	0.90	F	99 sec	1.22
Kneeland/Tyler	B	8 sec	0.75	D	29 sec	1.05
Kneeland/Hudson	C	14 sec	-	D	23 sec	-
Kneeland/Surf. Art.	D	34 sec	1.02	F	144 sec	1.27
Oak/Tremont	B	8 sec	0.35	B	9 sec	0.67
Oak/Washington	B	11 sec	0.63	B	12 sec	0.71
Oak/Harrison	A	6 sec	-	D	22 sec	-
Marginal/Arlington	B	7 sec	0.31	B	9 sec	0.57
Marginal/Tremont	B	12 sec	0.73	B	14 sec	0.86
Marginal/Shawmut	B	10 sec	0.48	B	13 sec	0.77
Marginal/Washington	A	3 sec	0.45	B	7 sec	0.45
Marginal/Harrison	A	4 sec	0.16	A	3 sec	0.34
Herald/Tremont	B	12 sec	0.63	B	11 sec	0.58
Herald/Shawmut	B	10 sec	0.50	B	15 sec	0.80
Herald/Washington	B	11 sec	0.74	B	12 sec	0.77
Herald/Harrison	B	13 sec	0.75	D	27 sec	1.02
Herald/Albany	C	20 sec	0.91	F	114 sec	1.23
Herald/Frontage & Broadway	F	237 sec	1.51	F	136 sec	1.36
E.Berkeley/Tremont	D	26 sec	1.03	C	16 sec	0.79
E.Berkeley/Shawmut	B	6 sec	0.50	B	9 sec	0.47
E.Berkeley/Washington	B	8 sec	0.62	B	9 sec	0.48
E.Berkeley/Harrison	B	13 sec	0.83	B	11 sec	0.83
E.Berkeley/Albany	C	19 sec	0.92	C	17 sec	0.89
E.Berkeley/Frontage & W. Fourth	F	1065 sec	1.48	D	28 sec	1.02

4.3 Year 2000 Build Impacts - Base Case Vehicular

The year 2000 vehicular traffic volumes (Figures 3.8 and 3.9) developed in the last chapter were subjected to LOS analyses on the existing roadway network, with the results shown in Table 4.2. No intersections experienced LOS deficiencies that were not evident in the No-Build LOS results, although delay was increased at the previously identified locations. Figure 4-1 compares AM and PM peak hour intersection LOS under Existing, No-Build and Build conditions.

The impacts of the Build condition have to be viewed relative to the No-Build to ascertain the extent to which the projects under study create any future traffic traffic problems. In this case, if only the proposed projects under this report were built, the traffic conditions would not change perceptibly beyond existing conditions, where only two intersections are at unacceptable LOS, and that only in the AM peak hour (Herald/ Frontage/ Broadway and E. Berkeley/ Frontage/ W. Forth). Given the magnitude of existing traffic levels and the much larger No-build growth, the projects of this report are relatively minor traffic contributors. This is discussed further below in Section 4.12, Impact Perspective.

4.4 Context of Roadway Alternatives Analyses

As noted at the beginning of this chapter, the roadway alternatives involve the effects of the CA/T project and a related proposed building of Turnpike ramp(s). These actions are the responsibility of State and Federal agencies who have an ongoing process related to these alternatives. This study was not intended to be a major actor in the CA/T development process, but rather to concentrate on the development proposals and local access requirement, while giving some perspective to the effects of regional actions being determined by a decision process involving many more interests.

The alternative analysis work in this study was done at a point in time in advance of the CA/T Final Environmental Impact Statement (FEIS), based on information available. Meanwhile, voluminous new (or updated) work was done by the CA/T project for the FEIS. Nevertheless, within its context, the alternatives discussion of this present report has validity. This context varies from CA/T FEIS and related work in the following respects:

- o One CA/T scheme is used to assess the CA/T effect on the Study Area, looked at with and without new Turnpike ramps to/from the Back Bay. This basic scheme included all ramp connections to Marginal Road. It was not part of this work to consider a series of CA/T project variations in and around Chinatown.
- o The analysis time frame for this study is different (Year 2000) than for the CA/T project (Year 2010).

Table 4.2
Future Build Level of Service (LOS) Analysis Summary

<u>Location</u>	<u>LOS</u>	<u>AM Peak Hour</u>		<u>LOS</u>	<u>PM Peak Hour</u>	
		<u>Average</u>	<u>V/C</u>		<u>Average</u>	<u>V/C</u>
		<u>Delay</u>			<u>Delay</u>	
Stuart/Tremont	F	67 sec	1.24	F	601 sec	1.96
Kneeland/Washington	C	21 sec	1.02	D	37 sec	1.18
Kneeland/Harrison	C	20 sec	0.90	F	101 sec	1.23
Kneeland/Tyler	B	8 sec	0.76	D	30 sec	1.05
Kneeland/Hudson	C	14 sec	-	D	25 sec	-
Kneeland/Surf. Art.	D	36 sec	1.03	F	150 sec	1.27
Oak/Tremont	B	8 sec	0.35	B	9 sec	0.68
Oak/Washington	B	11 sec	0.64	B	12 sec	0.72
Oak/Harrison	A	6 sec	-	D	22 sec	-
Marginal/Arlington	B	7 sec	0.31	B	10 sec	0.58
Marginal/Tremont	B	12 sec	0.74	B	15 sec	0.88
Marginal/Shawmut	B	10 sec	0.50	B	14 sec	0.79
Marginal/Washington	A	4 sec	0.47	B	7 sec	0.48
Marginal/Harrison	A	4 sec	0.17	A	3 sec	0.36
Herald/Tremont	B	13 sec	0.67	B	11 sec	0.59
Herald/Shawmut	B	10 sec	0.51	B	16 sec	0.86
Herald/Washington	B	12 sec	0.76	B	14 sec	0.80
Herald/Harrison	B	13 sec	0.76	D	33 sec	1.06
Herald/Albany	C	20 sec	0.91	F	132 sec	1.27
Herald/Frontage & Broadway	F	238 sec	1.51	F	142 sec	1.36
E.Berkeley/Tremont	D	28 sec	1.03	C	16 sec	0.79
E.Berkeley/Shawmut	B	6 sec	0.52	B	9 sec	0.48
E.Berkeley/Washington	B	8 sec	0.63	B	9 sec	0.49
E.Berkeley/Harrison	B	13 sec	0.84	B	11 sec	0.62
E.Berkeley/Albany	C	20 sec	0.94	C	18 sec	0.90
E.Berkeley/Frontage & W. Fourth	F	1077 sec	1.51	D	28 sec	1.02

- o The traffic volume changes for this report are based upon total traffic approaching each intersection studied, while volumes reported in CA/T work are usually for individual roadway segments. Thus, the comparison of numbers in this report and in CA/T work is to be avoided because of analysis year and traffic volume type differences.
- o The summary of effects in this study considers locations throughout the Study Area, while CA/T focus is more specifically on Marginal Road.

Within the above limitations, this study confirms certain aspects of the CA/T actions with respect to the local situation.

Overview/Summary of CA/T Effects

In broad terms, the CA/T project simply provides more expressway capacity in its corridor, partly by Artery widening, and partly by linking to a new Harbor Tunnel to the Airport and beyond, as a diversion to Downtown roadways. It would be expected that the project would generally reduce extraneous traffic on local streets in the general corridor. The study shows that, overall, such is the case if the area (bounded by E. Berkeley, Tremont, Kneeland, and Albany Streets) is viewed as a whole.

On the other hand, where connections to a new expressway facility are focused on particular local streets, greater traffic volumes will occur. In the CA/T project, ramp connection from the project focus upon Marginal Road, where increases in traffic exceed general growth. The CA/T layout and ramp arrangement eliminate the existing Beach Street I-93 southbound offramp, replacing it in effect by the link to Marginal (via Ramp M). In addition, the new Harbor Tunnel/Seaport Access Road westbound (via Ramp DD) plus I-93 northbound (via Ramp KD) connect into Marginal Road for access to the area. Traffic volumes on Marginal are of course higher, by a greater degree with all the links in place, as is the case in the analyses of this report.

The extent of the increase is seen in the section of Marginal east of Washington, where the existing street layout protects the street from direct access from other arterials. The existing layout feeds the section west of Washington Street as part of a one-way pair with Herald Street across the Turnpike, so that future continuing arterial use of this section is less marked. The analysis in this report only contains the intersection of Marginal and Shawmut as an indicator. Thus the increases for Marginal do not appear as dramatic as they would further east. The conclusion is clear (notably in the AM peak when traffic is dominantly inbound), however, the CA/T as proposed would make Marginal arterial in nature for its full length, instead of just west of Washington, where heavier usage is evident today.

The proposal to have an outbound Turnpike connection to the Back Bay via a new ramp to Berkeley Street should to provide some relief to Marginal. The analysis contained herein, however, indicates that this would be limited. The reason for this is that because certain traffic diverts to the Turnpike, other vehicle trips find Marginal more attractive and re-route from yet other roadways. The CA/T FEIS shows that the relief effect of the new Turnpike ramp is more evident on Marginal west of Shawmut Avenue.

The following analyses are in consonance with the above discussion, even though derived from somewhat earlier CA/T traffic network assignments. The assignment process is often very sensitive to slight changes, but the end conclusion seems to be that, with or without the new Turnpike ramp(s), the section of Marginal Road east of Washington will become arterial in nature like that to the west if the CA/T project is connected as planned. One offsetting feature will be the protection of Hudson Street.

If connections to Marginal are reduced or eliminated, it would be expected that traffic on Essex, Kneeland, Herald and East Berkeley Streets would have to carry the displaced volumes.

Description of Roadway Alternatives

The alternative roadway conditions being considered involve the addition of the planned major Central Artery/Third Harbor Crossing (CA/T) project and/or a modification of Turnpike ramp connections which could affect the Study Area. The projects are as follows:

CA/T Project. This major undertaking involves the depression and widening of the Central Artery from Massachusetts Avenue to Charlestown plus the construction of a new Harbor tunnel as an extension of the Turnpike, routed through South Boston industrial land to Logan Airport in East Boston and beyond. This project entails of course the creation of new and the modification of old ramp connections. The purpose of the project is to give better service to growing major regional traffic flows while relieving local streets of significant arterial volumes. The hope for the Study Area is that certain types of traffic which now uses local streets to bypass Central Artery congestion will remain on the much improved regional system. One major feature of the CA/T affecting the Study Area is the creation of a southbound off-ramp leading into Marginal Road (with a branch also connecting to the Turnpike). Major traffic volumes using this connection could offset the intent of the Turnpike ramp changes noted below.

Turnpike Ramp Changes. In an effort to divert some traffic on local streets to the Turnpike while giving more immediate access to the regional system from the South End, Chinatown and Back Bay, and Back Bay, Turnpike ramp changes have been proposed. The most extensive changes would involve the creation of both an outbound off-ramp at

Berkeley Street and an inbound on-ramp at Tremont Street, fed by an extension of Herald Street from Tremont west to Clarendon Street. The existing Arlington Street outbound ramp would have to be eliminated to allow the outbound off-ramp to Berkeley.

The effects of the proposed changes on Marginal Road and to a lesser extent on Herald Street are of greater local interest in the Study Area, as Marginal Road is immediately adjacent to Chinatown residential and school areas. As consideration of the total ramp changes evolved, the inbound ramp from Tremont Street with the Herald Street extension have been eliminated from planning due to physical feasibility (passage over railroad tracks, etc.) and funding restraints. Only the outbound ramp proposal to Berkeley Street is now being considered, and it is this alternative which is being evaluated in this report. The expectations here would be in the reduction of westbound traffic only on local streets, notably Marginal Road. This ramp proposal is being (comprehensively) assessed by the Turnpike Authority in an Environmental Impact Report.

4.5 Effects of Roadway Alternatives

Alternative Analysis Methodology. To obtain a measure of the effect of the CA/T project and/or the Turnpike ramp changes on the Study Area, a method was devised to indicate at key intersections how the two proposals affected traffic volumes relative to the base case year 2000 Build conditions. This was done by comparing the results of traffic model (TRANPLAN) roadway network assignments done as part of a study of Back Bay traffic by Cambridge Systematics Inc. (CSI) for the City of Boston, but derived directly from a larger model developed also by CSI for CA/T future traffic analysis purposes. The assignments referred to fortunately included the Study Area, and included all proposed development projects to the target year 2010, projected from a base year 1987.

Since this study has a base year 1987 and a future target year 2000, the network assignments (1987 & 2010) had to be adapted to this shorter period. It was decided to use a relative growth factor method for comparisons of base case growth with growth in association with network assignments with the CA/T and Turnpike ramp changes. Assignments comparing total approach volumes at 16 of the 27 Study Area intersections on the existing network with year 2010 volumes with the CA/T were further compared with the changes estimated in the base case of this report. The number of intersections used was limited by the nature of the traffic assignment output.

To make the time periods comparable, an annual (compound) growth rate was calculated for the change in assignments and projected over 13 years to the target year 2000. Comparison of the changes in intersection volumes with and without the CA/T show the extent to which the CA/T project relieves each intersection. Variants with and without the Turnpike ramp changes allow further evaluation of these changes at each intersection. In essence, growth factors in total intersection approach volumes were calculated and compared for the following conditions, after adjusting to the common future year of 2000:

<u>"Present" Conditions</u>	<u>"Future" Conditions</u>	<u>Approach Volume Sources</u>
1. 1989 existing roads	Base Build, No CA/T	1989 counts, 2000 Build
2. 1987 network	2010 network, CA/T only	1987, 2010 assignments
3. 1987 network	2010 network, CA/T <u>and</u> Turnpike Ramp change	1987, 2010 assignments

It should be pointed out that this method is not a precise tool, but the overall results should give an indication of real differences. Growth factor comparison was done as absolute values were not directly comparable between assignments and other volume sources. In addition, since changes at any given location can result from either a difference in volume demand and changes in the system, the proration of assignment changes to the common future year may not be totally valid, as either the physical changes are in or not, apart from the volume demand factors. Limitations in the availability of actions of assignments hampered compensating for this effect. Despite this caveat (with respect to "apples and oranges"), it is felt that the results are of use in evaluating CA/T and Turnpike ramp change effects.

Effects of Alternatives. The results of the analysis can be seen in Figure 4.2 and 4.3 which present a comparison of the total estimated AM and PM peak hour approach volumes at 16 intersections for all future alternatives - no CA/T, CA/T only, and CA/T with the Turnpike intersections for all future alternatives - no CA/T, CA/T only, and CA/T with the Turnpike ramp change. It can be seen that the effect varies from intersection to intersection, but that, overall the CA/T project provides a volume reduction on the average, with a smaller further, but more limited, reduction evident with the Turnpike ramp change.

The results can be seen in aggregate in Figures 4.4 and 4.5 expressed as a multiple of the total existing counted approach volumes at the 16 intersections for the AM and PM peak hours. This shows the relative changes in total demand for the conditions shown. The following table expresses these changes as a ratio to existing counts.

<u>Condition</u>	<u>Ratio of Change to Existing Counts</u>	
	<u>AM Peak Hour</u>	<u>PM Peak Hour</u>
Existing Counts (1989)	1.00	1.00
No-Build	1.24	1.24
Build	1.26	1.26
Build with CA/T	1.02	1.06
Build with CA/T & Tpke.Ramp	1.02	1.02

Although it may be violating the limits of precision, a look at the changes which the alternative conditions cause at the intersections which experience Build LOS worse than D is of interest.

<u>Intersection</u>	<u>Peak Hour</u>	<u>Build LOS</u>	<u>% Volume Reduction from</u>	
			<u>CA/T</u>	<u>CA/T + Tpke.Ramp</u>
Stuart/Tremont	AM	F	- 6%	-10%
Stuart/Tremont	PM	F	-15	-21
Kneeland/Harrison	PM	F	-16	-20
Kneeland/Surface Artery	PM	F	-21	-19
Herald/Frontage/Broadway	AM	F	na	na
Herald/Frontage/Broadway	PM	F	na	na
Herald/Albany	PM	F	-21	-28
E. Berkeley/Frontage/W. 4th	AM	F	-34	-20

The above table indicates that all intersections experience a reduction in traffic demand from the Artery project, ranging from 6% up to 34%. While these reductions may not in all cases be able to bring the LOS into the acceptable range, conditions should improve markedly by the implementation of the CA/T project. The further reduction by the Turnpike ramp change is relatively minor, particularly in the AM peak hour. And, at two intersections, the ramp proposal reduces traffic less than the case of the CA/T alone. At Kneeland/Surface Artery, the ramp proposal reduces traffic by 19% over base year levels, compared to 21% for the Artery project alone. At E. Berkeley/Frontage/W. Fourth Street, the ramp proposal reduces traffic by 20%, compared to 34% with the CA/T project alone.

An overview of the ability of the alternatives to relieve future traffic enough to produce acceptable LOS may be obtained by remembering that most of the unacceptable LOS were brought about by the No-Build growth of about 24% (corresponding to the 1.24 ratio above), while overall levels, including project contributions were reduced to within only 2%-6% above existing (corresponding to the 1.02 and 1.06 ratios above). In general terms, it may be concluded from the above that the CA/T project will go far in restoring traffic LOS to reasonable levels. It is felt that the probable lack of precision in the individual intersection percentages does not warrant precise recalculation of specific LOS. The individual values show that there will be variability in effect, as would be expected, even though the overall outlook shows improvement.

Comment on Marginal Road and Herald Street. The proposed Turnpike ramp changes were in part motivated by a desire to relieve traffic on Marginal Road and Herald Street. Based upon observing a number of network traffic assignments with and without one or other of the two originally proposed ramps, the traffic relief observed was minor at best for both roadways. The main reason for this is that although the new ramps attracted

COMPARISON OF TOTAL APPROACH VOLUMES AT 16 INTERSECTIONS (AM PEAK)

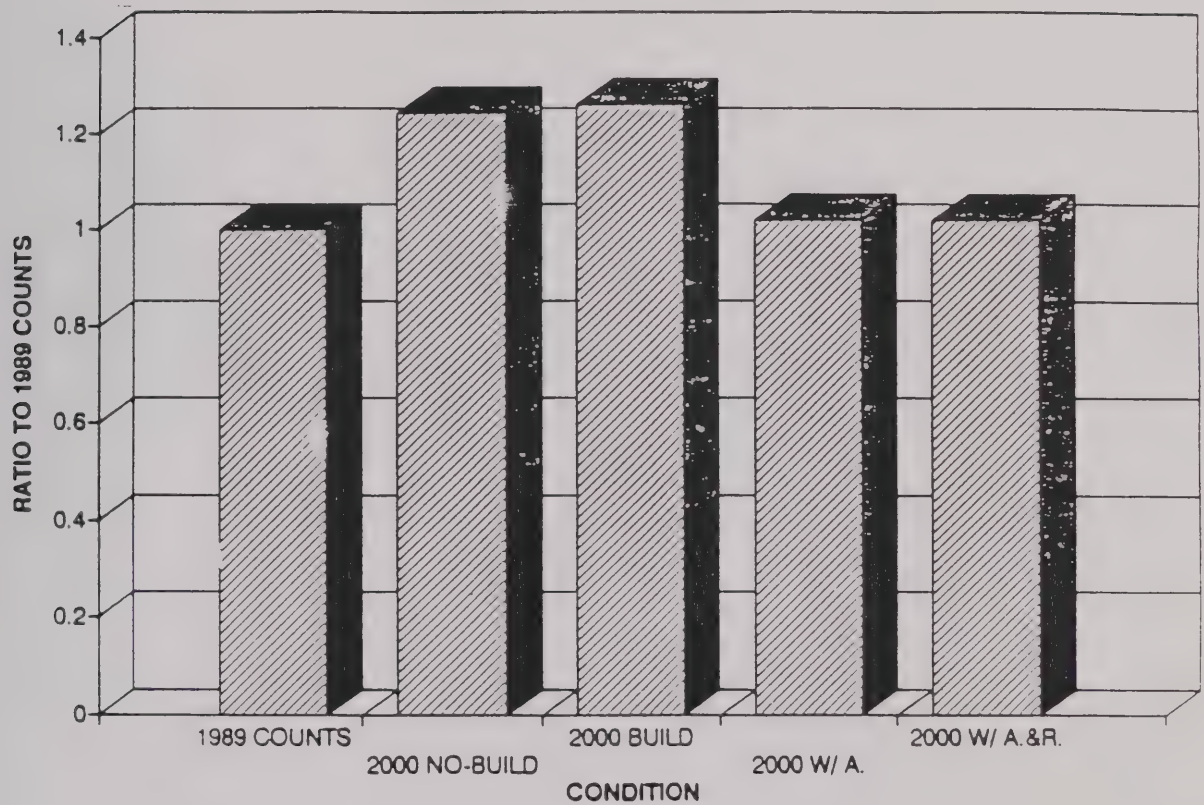


Figure 4.3

COMPARISON OF TOTAL APPROACH VOLUMES AT 16 INTERSECTIONS (PM PEAK)

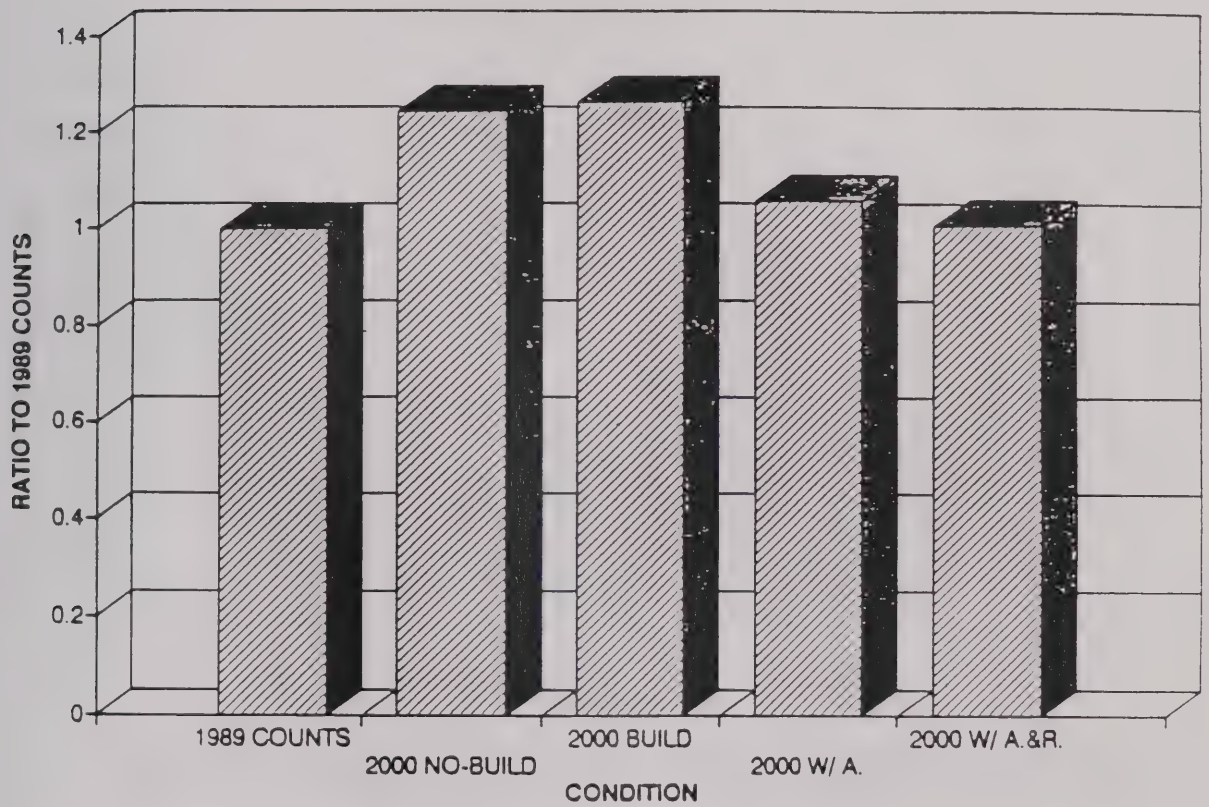
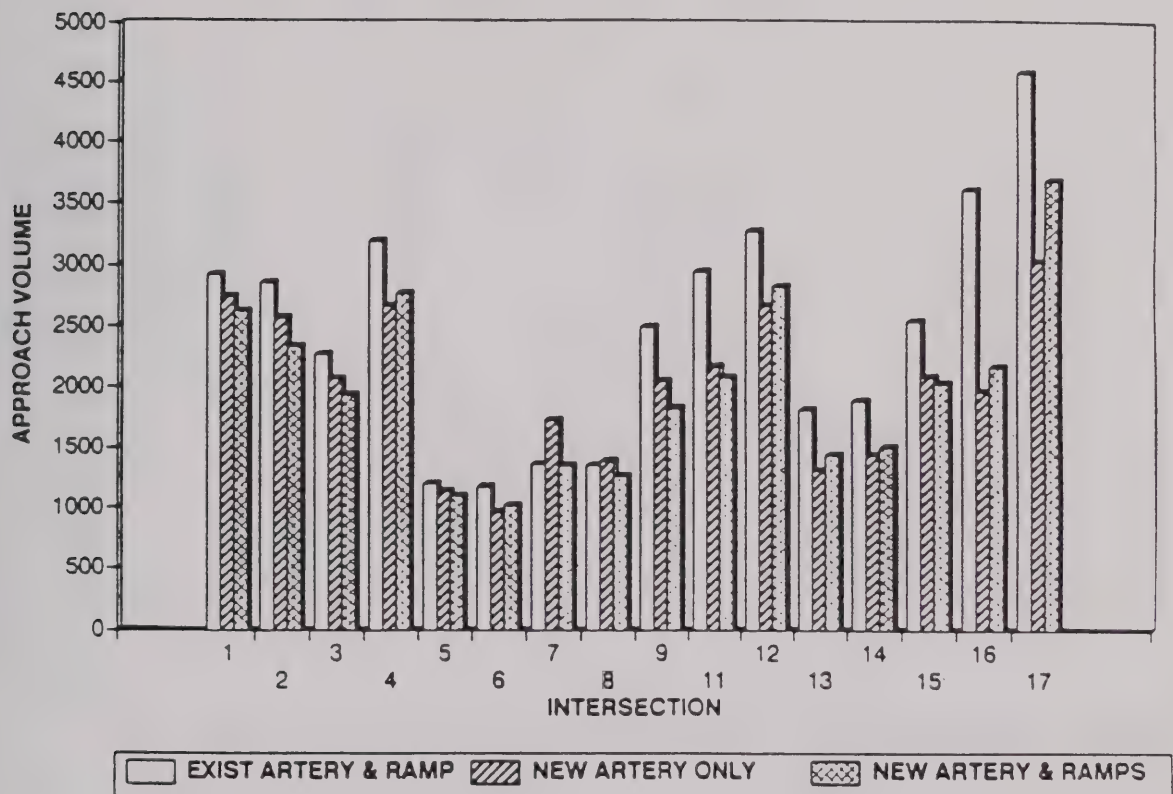


Figure 4.4

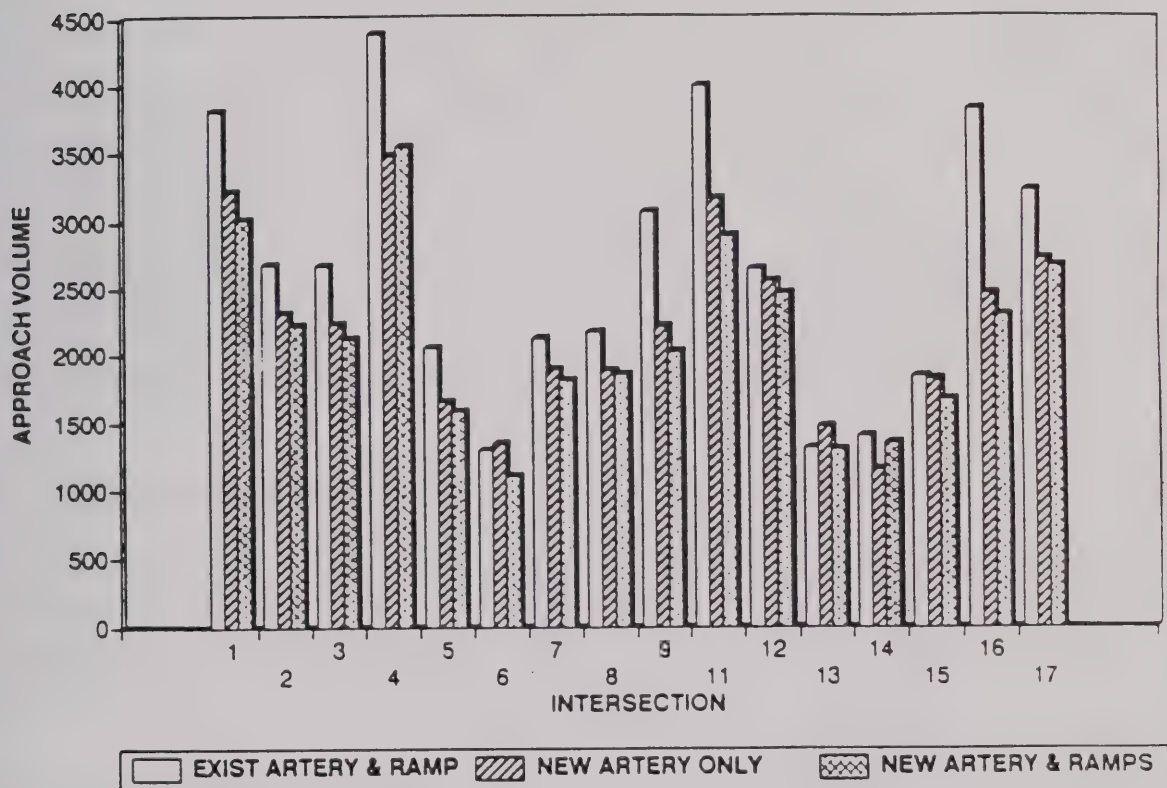
COMPARISON OF TRAFFIC PROJECTIONS (AM) WITH AND W/O NEW ARTERY/ T'PIKE RAMPS



KEY:

- 1- Stuart/Tremont
- 2- Kneeland/Washington
- 3- Kneeland/Harrison
- 4- Kneeland/Surface
- 5- Oak/Tremont
- 6- Oak/Washington
- 7- Marginal/Shawmut
- 8- Herlad/Shawmut
- 9- Herald/Washington
- 10- Herald/Albany
- 11- E. Berkly/Tremont
- 12- E. Berkly/Shawmut
- 13- E. Berkly/Washington
- 14- E. Berkly/Harrison
- 15- E. Berkly/Albany
- 16- E. Berkly/Frontage & Fouth

COMPARISON OF TRAFFIC PROJECTIONS (PM) WITH AND W/O NEW ARTERY/ T'PIKE RAMPS



KEY:

- 1- Stuart/Tremont
- 2- Kneeland/Washington
- 3- Kneeland/Harrison
- 4- Kneeland/Surface
- 5- Oak/Tremont
- 6- Oak/Washington
- 7- Marginal/Shawmut
- 8- Herald/Shawmut
- 9- Herald/Washington
- 10- Herald/Albany
- 11- E.Berkly/Tremont
- 12- E.Berkly/Shawmut
- 13- E.Berkly/Washington
- 14- E.Berkly/Harrison
- 15- E.Berkly/Albany
- 16- E.Berkly/Frontage & Fouth

considerable traffic, much of it was diverted traffic from routes outside of the Study Area, leaving volumes on Marginal and Herald close to the situation with the existing ramp arrangement. The ramps apparently serve their other purpose of providing a better route for traffic to the expressway system very well.

Since the inbound on-ramp from Tremont Street with the Herald Street extension is no longer a valid proposal, relief to Herald Street will not be addressed through this change. It is therefore fitting to concentrate more on the outbound off-ramp to Berkeley Street, which should relieve Marginal Road. The main reason why relief is minimal appears to relate to the fact that a new Artery southbound ramp connection feeds directly into Marginal, which is not the case with the existing ramp configuration. The closest corresponding existing Artery ramp is the southbound off ramp to Beach Street/Surface Artery adjacent to Chinatown. The conclusion to be reached here is that the new ramp connection to Marginal increases traffic on Marginal, and that the provision of the new Turnpike ramp attracts much traffic from other routings outside of the Study Area. This analysis indicates that due to the Marginal Road ramp from the Artery, the effects of the Turnpike ramp change are minimal. Whether or not the EIR being undertaken on the Turnpike ramp comes to similar conclusions remains to be seen.

4.6 Other Traffic Impact Issues

Several other traffic impact issues are associated with the NEMC Phase 1-C development and the proposed Chinatown housing developments, as discussed below. These are local in nature and more confined in effects than the large and more "global" Central Artery and Turnpike issues discussed above.

Moving of Ambulance Entrance

As part of the NEMC 1-C building program, the NEMC ambulance entrance will be moved from Harrison Avenue to Washington Street, as shown in Figure 3.7, above. Ambulance activity at the current entrance on Harrison Avenue represents about 25 vehicles per day. An AM and PM peak period count conducted for this study at Harrison Avenue and Oak Street showed only two ambulances in the PM peak hour, and none in the AM peak hour. Of course, it is impossible to predict the exact times and frequency of ambulance activity. The major impact of moving the entrance will be positive in that the entrance will be removed from a block with some residences to a block with no residences. This issue will be more fully addressed in the Project Impact Report for the 1-C development.

Moving of Maternity Entrance

To accommodate 1-C construction activity, the drop-off area and entrance for maternity admissions (in the existing hospital space) will be temporarily moved to the pediatric entrance of Floating Hospital on Washington Street. Temporary parking for 6-8 cars will be available. This arrangement will last only until 1-C is completed.

Alternative Parking Access for Chinatown Housing Parcels

Two issues exist in the possible parking alternatives for Chinatown Community projects:

- o The extent to which parking resources may be shared, and
- o What parking entrance/exit arrangements are best.

It should be first observed that at the present time, no parking is planned for Parcel C, the Community Center, on the premise that, due to the function of the Center, most users would gain access by walking from the community. This is probably substantially true, even though for project travel estimation purposes up to 92 vehicle arrivals and departures have been estimated in the larger (PM) peak hour. This was done to make sure that total project vehicle access is not understated. Some minimum parking arrangements should be made available, either by on-site addition, or by sharing nearby parking facilities, such as that available to Parcels A and B, the Community Housing developments.

Parcels A and B comprise a total of 261 housing units served by a planned 250 parking spaces. Based on the 1980 Census indication that Chinatown residents own 1 car for every 3 residences (See Section 2.2), it is possible that the parking demand for the proposed housing could be as low as about 90 cars, although 250 spaces (almost one per unit) are proposed. And, as shown in Table 3.8, with an estimated 80% occupancy in the daytime, peak period demand would be only 73 cars. Even if evening demand increased to double this amount, or 180 spaces, there would still be up to about 70 spaces available for sharing with the Community Center. In the daytime, from 100-170 spaces would be available for potential sharing with NEMC. For the security and convenience of the residents, however, this would have to be done on a very controlled basis.

For optimum space deployment, it is desirable to have internal connections between the Parcel A and B garages, or have the parking designed into what is effectively one garage. (It has already been determined that connecting to an underground garage under Parcel C is infeasible due to high utility relocation costs.) Any Parcel A and B garage connections will also have to be decided on cost and underground utility disruption factors in the final design phase. If the 250 spaces can be integrated, one entrance/exit location is adequate, otherwise, two would of course be necessary. Two arrangements are proposed:

1. If the parking is divided, Parcel A should provide access from Marginal Road, and Parcel B, from Washington Street. These are both major streets providing access via "round the block" circulation, and the locations relate directly to each site served. Due to the one-way nature of Marginal Road and the physical median in Washington Street, only right turns in and out would be possible at each driveway.
2. If the parking is combined, one driveway from Washington Street, more centrally located to both sites, would be adequate.

Spaces within the garage(s) should be specifically assigned to residents in clearly defined areas, with any excess spaces set aside for visitors and possible shared parking in separate sections. The provision of spaces to acceptable outside users on a leased basis would naturally generate revenues for the housing.

4.7 Parking Conditions

The question of expanded parking capacity to meet the needs of the Medical Center has been under consideration for several years and has been the subject of intense community interest. Several on-site and off-site alternatives for increasing Medical Center parking supply were the subject of the 1986 Parking Needs and Site Evaluation Study conducted for NEMC by Vanasse Hangen and referenced elsewhere in this report. The alternatives analysis is well documented in the 1986 report, and so is not repeated here.

Since that study, an extensive community participation process has occurred, and agreements have been reached with Chinatown neighbors regarding usage of parcels within the Medical Area formerly proposed for parking, as well as acceptable fringe parking options.

In the proposal around which consensus has been reached, New England Medical Center has agreed to a land exchange whereby land on Parcels A, B, and C can be used by Chinatown development interests for housing, as outlined above. To meet parking needs, NEMC is seeking to enter into an arrangement for continued leasing of parking spaces in the Herald Street Garage. Under discussion with the BRA and the current owner of the garage is a proposal to provide employee and student parking in a newly built and expanded facility, with provisions for use by the adjacent Castle Square residential tenants.

The Boston Redevelopment Authority recently approved the sale of Castle Square upon expiration of its initial development agreements with the City. Under this agreement, the garage will remain under its present ownership. As proposed, the new garage would be built on the site of the existing 400-car garage, at Herald Street between Shawmut Avenue and Paul Street. Under the current agreement, the expanded garage would include 650 spaces for the Medical Center and 150 spaces for residents of the adjacent Castle Square development. At this time, there is no specific garage design. Following resolution of the land transfer action being sought at this time, the design of the garage will be subject to the

state and city's review processes. For purposes of analysis, apart from the proposed size, an assumption has been made that the garage entrance and exit would remain on Herald Street as they are today. However, several different options, dependent upon the design process, have been discussed. In addition, other sites south of the Turnpike have been considered for NEMC parking subsequent to the analyses performed for this study, as discussed in the Appendix.

It is noteworthy that the existing garage has several structural problems. Although only twenty years old, major sections of the roof level have had to be replaced. Future maintenance costs to deal with continuing deterioration will likely be high.

Overall NEMC Parking Supply and Demand

In terms of parking supply and demand, the proposed garage will basically replace parking to be lost at NEMC as buildings are constructed on parking lot sites, and leases with private operators are not continued. NEMC parking in an 800 car facility would include the following groups of parkers:

- Existing parkers (staff/students):	400 spaces
- Employee parking displaced by 1-C:	
- Washington St. lot (evening shift only):	60 spaces
- Oak Street lot:	70 spaces
- New parking to meet 1-C expansion needs:	120 spaces
- Castle Square tenant parking:	150 spaces
Total	800 spaces

As shown above, the garage expansion would accommodate only 120 spaces for NEMC Phase 1-C expansion, compared to an estimated demand of 233 spaces, of which 165 are for employees and 68 for visitors. Visitor parking, however, would not be accommodated at this fringe facility in any event, but would be accommodated in the existing Tremont Street Garage and Harrison Avenue lot. In addition, the 60 spaces in the Washington Street lot are reserved today for evening shift workers only, and would more conveniently be replaced within the medical area rather than in a fringe facility. Thus, about 60 additional spaces will be available at Herald Street to meet daytime employee demand generated by 1-C, for a total of 180, which easily meets the demand.

As proposed, the Herald Street Garage would also contain 150 spaces reserved for use by Castle Square residents. Today, Castle Square has approximately 294 on-site parking spaces (267 off-street in surface lots and 27 metered spaces along the Tremont Street service road) to serve its 500 dwelling units and 53,000 square feet of commercial space. Adding an additional 150 residential spaces in the garage would bring the total spaces to 444, or .89 spaces per unit.

Parking Freeze Issues

Phase 1-C development will displace 130 spaces in the Washington and Oak Street lots. These spaces are currently restricted to NEMC staff use and are not "commercial spaces" as currently defined in the City of Boston Parking Freeze regulations. Similarly, the proposed new spaces in the Herald Street Garage would not be open to the general public for a fee at any time, and would not qualify as "commercial spaces" under the freeze. Thus, the Herald Street Garage expansion project would not require a Parking Freeze Permit from the City of Boston Air Pollution Control Commission, although it would be necessary to file for an exemption on the grounds that the spaces are for employees and students only and are clearly not open to the public.

4.8 Transit Impacts

The increased numbers of transit riders attributable to NEMC Phase 1-C and the Chinatown developments are insignificant in terms of MBTA peak period carrying capacity, and will not impose an undue burden on any of the MBTA's rapid transit, commuter rail, or bus lines or stations. The highest volumes to be generated in the peak period by Phase 1-C development would be 130 total transit trips in the PM peak hour, distributed among all lines. Ninety of these trips would use the NEMC station, to access the Orange Line directly or to use the Orange Line and then transfer to other lines.

Ridership by line and direction was estimated through applying the trip distribution for commuter rail and subway riders to the overall transit ridership estimates presented in Table 3.5, as shown in Table 4.3 below. As shown, the maximum ridership on any one line is on the Orange Line north, with 16 riders per hour in the peak direction in the PM peak hour.¹ This represents only around one tenth of one carload of people per hour, compared to a peak hour capacity of 78 Orange Line cars combined into 14 trains in the PM peak, capable of carrying over 12,000 people, as shown in Table 4.4 and 4.5. Thus, there is no noticeable impact on transit capacity on any line.

4.9 Pedestrian Impacts and Nassau Street

Similarly, the proposed projects will not add undue pedestrian travel to study area sidewalks and crosswalks. As shown in Table 3.3, Total Person Trip Generation, the NEMC project will add about 370 person trips in the morning and about 400 person trips in the evening, all of whom will be pedestrians at some point in their commute, whether walking from a transit station, a bus stop, or a parked car. Only a few -- around 25 in the morning and 25 in the evening -- will walk exclusively as a commute mode, however.

1. (Note: Green line west ridership of 18 people in the PM peak is spread among the four Green Line branches.)

Table 4.3
Estimated NEMC Phase 1-C Transit Ridership by Line and Direction

<u>Transit Mode</u>	<u>Daily Riders</u>		<u>AM In</u>		<u>PM Out</u>	
	<u>Number</u>	<u>%</u>	<u>Number</u>	<u>%</u>	<u>Number</u>	<u>%</u>
Total Transit	1,327	100.0%	124	100.0%	130	100.0%
Subway:	929	70.0%	87	70.0%	91	70.0%
Orange Line South	111	8.4%	10	8.4%	11	8.4%
Orange Line North	168	12.7%	16	12.7%	16	12.7%
Red Line North	118	8.9%	11	8.9%	12	8.9%
Red Line South: Ashmont	76	5.7%	7	5.7%	7	5.7%
Red Line South: Braintree	106	8.0%	10	8.0%	10	8.0%
Green Line West	197	14.8%	18	14.8%	19	14.8%
Green Line Northeast	25	1.9%	2	1.9%	2	1.9%
Blue Line	128	9.6%	12	9.6%	13	9.6%
Commuter Rail	199	15.0%	19	15.0%	20	15.0%
Commuter Boat	13	1.0%	1	1.0%	1	1.0%

Table 4.4
MBTA Rapid Transit Peak Hour Capacity

<u>Line/Segment</u>	<u>PM Peak Cars/ Train</u>	<u>Sched. Headway</u>	<u>PM Peak Hr. Trips</u>	<u>PM Peak Hr. Cars</u>	<u>Car (Design) Capac.</u>	<u>PM Peak Hr. Capac.</u>
ORANGE						
Oak Grove - Forest Hills	6	4.5 min	11	66	155	10,230
	4	4.5 min	3	12	155	1,860
Total			14	78		12,090
GREEN						
N. Sta. - Cleveland Cir.	2	7.0 min	9	18	140*	2,520
Gov't Center - Boston Col	2	6.0 min	10	20	140	2,800
Gov't Center - Riverside	3	6.0 min	4	12	140	1,680
	2	6.0 min	6	12	140	1,680
Gov't Center - Reservoir	1	10 min	6	6	140	840
Brigham Circle - Lechmere	2	8.0 min	8	16	140	2,240
Total			43	84		11,760
RED						
Alewife - Ashmont	4	8.0 min	4	16	180	2,880
	6	8.0 min	4	24	180	4,320
"Run As Directed" (RAD)	6		1	6	180	1,080
Total, Ashmont			9	46		8,280
Braintree - Alewife	4	8.0 min	3	12	180	2,160
	6	8.0 min	5	30	180	5,400
Run As Directed (RAD)	6		2	12	180	2,160
Total, Braintree			10	54		9,720
Total			19	100		18,000
BLUE						
Bowdoin - Wonderland	4	3.5 min	17	68	110	7,480
"Run as Directed" (RAD)	4	3.5 min	1	4	110	440
Total			18	72		7,920
TOTAL TRANSIT LINES			94	334		49,770

Source: MBTA, Operations Directorate, Planning Division: Ridership and Service Statistics, October, 1988 *Tom Humphrey, CTPS ** Note: excludes Mattapan trolley service feeding Ashmont Station

Table 4.5

MBTA Transit Line Capacities and Ridership
Peak Hour, Peak Direction

<u>Peak Load Points</u>	<u>Scheduled Capacity*</u>	<u>Av. Passenger Load **</u>	<u>Volume/ Capacity</u>
RED LINE			
Between Andrew and JFK (Ashmont)	7,200	5,400 (PM)	.75
Between Andrew and No. Quincy (Braintree)	7,560	7,350 (PM)	.97
BLUE LINE			
Between Maverick and Aquarium	7,480	6,750 (AM)	.90
ORANGE LINE NORTH			
Between Haymarket and North Station	12,090	9,300 (AM) 8,900 (PM)	.77 .74
ORANGE LINE SOUTH			
Between Back Bay and NEMC	12,090	8,800 (AM) 7,650 (PM)	.73 .63
GREEN LINE WEST			
Between Arlington and Copley	11,760	10,000 (#)	.85
GREEN LINE NORTH			
Between No. Station & Science Park	2,240	1,100 (#)	.49

* Does not include additional carrying capacity of the "Run as Directed" trains. See Table IV A-4 for capacity analyses

** Sources: MBTA Ridership and Service Statistics, Operations Directorate, Planning Division, October, 1988 page 2-8; letter from Michael Burns to Howard/Stein-Hudson, December, 1988, (included as Appendix T4).

1986 estimate: 125 High Street DEIR, Vanasse/Hangen, Inc.

In peak commuting hours, it is estimated that about 120-130 pedestrians will travel in the peak direction in the peak hour to or from transit (primarily the NEMC Orange Line station), and about 140-150 to and from cars. Peak pedestrian travel, however, typically occurs in the midday, when people leave the buildings for lunch or errands.

The NEMC Master Plan provides creates a number of pedestrian links in both the east-west and the north-south direction, as shown in Figure 4.6. Automobile traffic will be restricted on Bennet Street to create a pedestrian passageway, connecting Harrison Avenue and the T/NEMC parking lot to the Pratt, Proger and Floating Hospital Buildings. This path is also a connecting link to reach the MBTA NEMC station entrance on Washington Street. Another important pedestrian link will be the realigned and extended Nassau Street. Nassau Street will both be extended to reach Washington Street, and will be realigned to be parallel to Oak Street. Along Nassau Street will be a new courtyard, which will house the main entrance to the 1-C buildings. This courtyard will also provide an open area adjacent to the proposed community center on Parcel C. Landscaping and sidewalk improvements, already begun by the Medical Center, will also be continued to enhance north-south pedestrian pathways on Washington Street and Harrison Avenue.

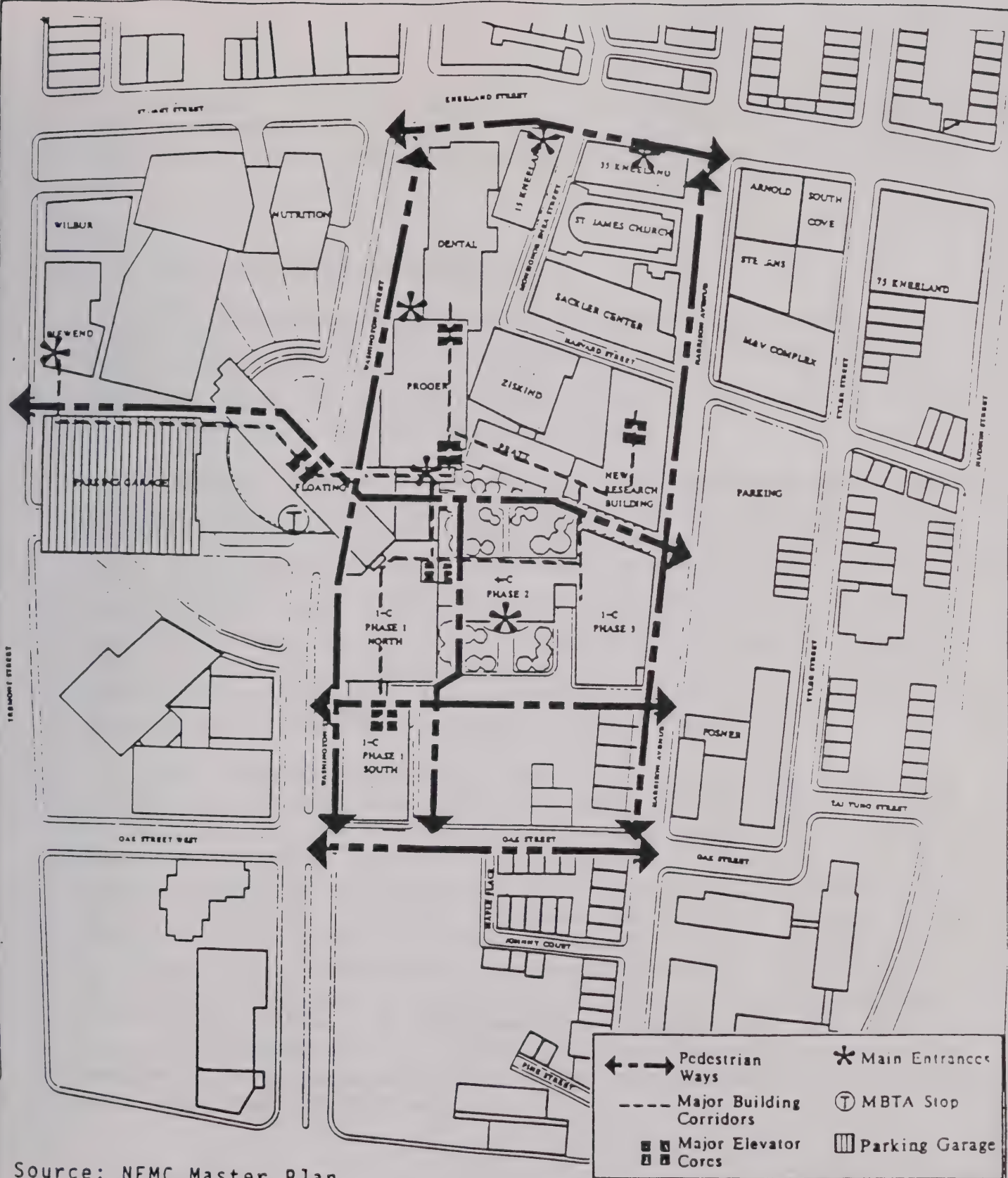
The extension of Nassau Street to Washington Street can also serve for improved vehicular circulation as a one-way westbound link. This link would allow the relatively low local access volumes to gain northbound access on Washington Street via right turns only, thereby eliminating circulation on Oak Street, in front of residential developments. Through traffic would not find this route very attractive, as the only access to the extension is from southbound Harrison Avenue, leading only to northbound Washington Street.

The Medical Center has recently engaged an urban designer to carry out the design phase of the NEMC Master Plan. The information in this impact study will help them develop measures to improve pedestrian movement in the corridors identified here.

4.10 Relative Impacts of Component Projects

This report focuses on a "project" which is actually four separate developments. To assess the relative impacts of each, it is necessary to see how much travel is generated by each. In Chapter 3, the contributions of each project to total vehicle volumes were discussed. In summary, the NEMC 1-C project contributes around 55% of peak hour trips, followed by the Recreation Center with less than 30%. The housing projects combined contribute 15-17% of peak hour trips.

This division of trips among the component projects is in a sense not too significant, as all the trips combined are a minor increment in traffic growth compared to existing and No-build volumes. Each individual project is simply a smaller subdivision of a relatively small total.



It may be further observed, as previously noted in Section 4.6, that the vehicular access to the Recreation Center is probably overstated, due to the local service which it intends. The fact that no or very limited parking is planned for the Center underscores this point.

4.11 Overview of Construction Impacts

The chief transportation impacts that are of concern during the construction period are traffic impacts on streets leading to and around the site, worker parking, unloading and loading of construction materials and equipment, and the enclosure of the site to protect pedestrians. All these matters require City licensing, and both good planning and coordination are necessary to insure that impacts are minimized.

A detailed Construction Management Plan will have to be prepared for each project in close coordination with the construction contractor. This plan must be submitted to and approved by the City of Boston Transportation Department prior to issuance of a building permit. It is not possible to detail the Construction Management Plan at this time, due to the long public approval and project financing process involved. The City permits and controls will all require specific input from responsible City agencies, which must take into account expected conditions at the time of construction, including coordination with other public, private or utility construction going on at the same time. With this in mind, however, it is possible to state a number of principles which will guide the construction process in order to reduce negative transportation-related impacts.

First, the phasing of construction work should be coordinated with other construction activities in the area. Likewise, the components of each development must be staged to minimize transportation related and other construction impacts. The project with the greatest potential conflict is the Central Artery/Third Harbor Tunnel project, where peak construction years are currently estimated to be 1991-1994, with the downtown portions occurring toward the end of this period. The highway section with the most impact on the Medical Area will be the I90-I93 interchange, the design contract for which will probably be initiated in 1991. Coordination with construction period plans for this interchange will be necessary, once the plans and schedules for each project are finalized. Depending on implementation schedules for the NEMC and Chinatown projects, it may be that their construction will be completed prior to the Artery construction; however, if the developments are delayed for a long period, the likelihood of construction occurring within the same time as the Artery construction will increase.

4.12 Impact Perspective

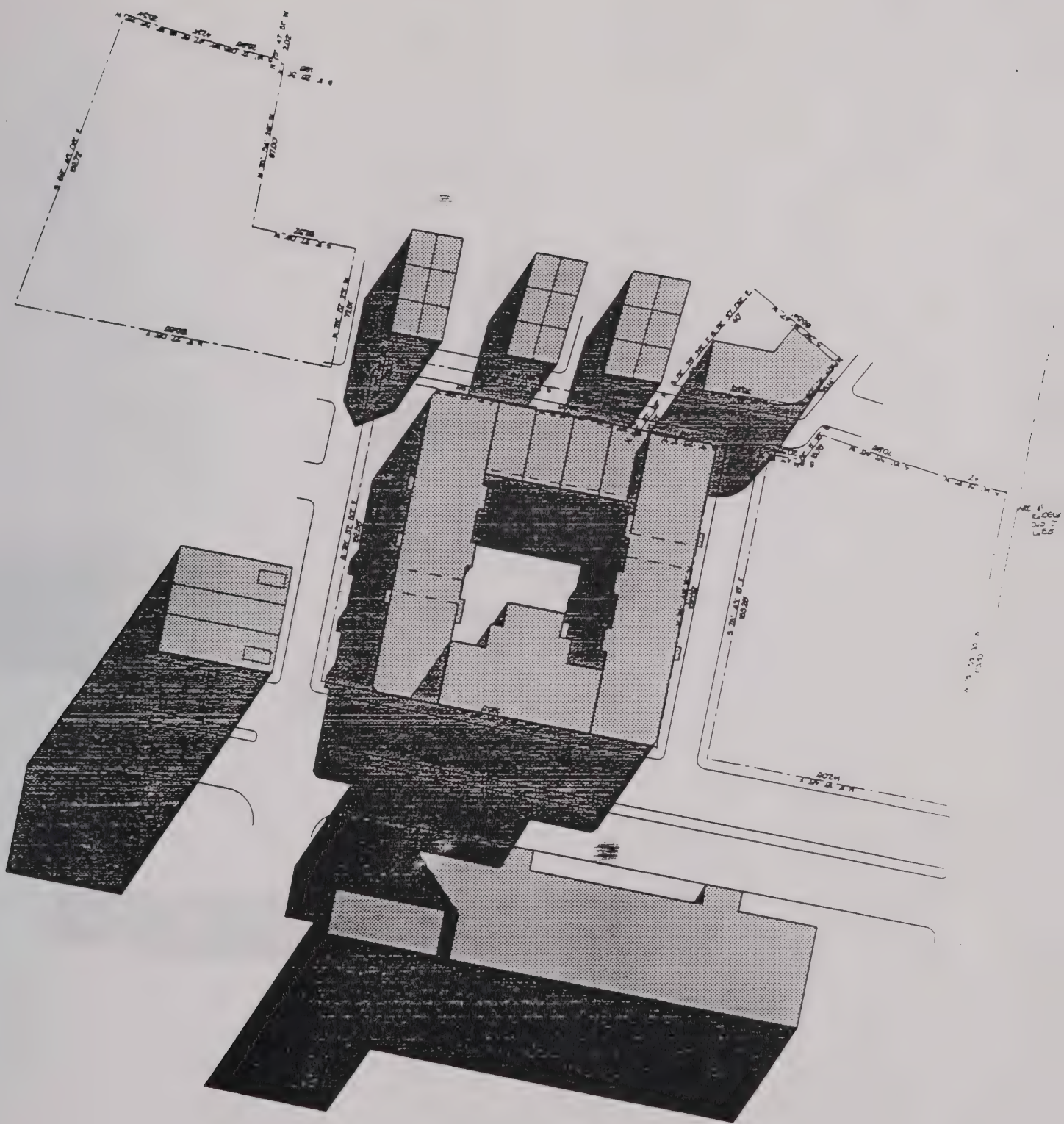
Much has been analyzed and described concerning the impacts of the project in a future context. The significance of the project as one development, or more correctly stated, four developments, should be seen in the perspective of other developments. From

the vehicular point-of-view, this can be seen in Figures 4.2 and 4.3 where the total approach volumes at several key intersections are shown as bar charts depicting the existing counts, volume additions of the No-Build development, and volume contributions of the project, for AM and PM peak hour traffic. It can be readily seen that the volume contribution of the project is small with respect to the other traffic sources. The implications of this are that the project is far from alone as an incremental development in causing traffic demands which may require mitigation. On the other hand, the charts provide a general basis for assigning a share of mitigating responsibility, where and when indicated. Each of the component four developments would of course have smaller shares, in keeping with their relative trip contributions, as discussed earlier.

What has been said for vehicle impacts also holds true in similar proportions for transit and pedestrian impacts. The new MBTA station and relocated Orange Line provides a good opportunity to increase transit usage by Medical Center staff and visitors without taxing system capacity. Sidewalks and pedestrian ways will be improved within the Medical Area as a result of the Master Plan design, and will accommodate both new and existing pedestrians more safely and more pleasantly than they do today.

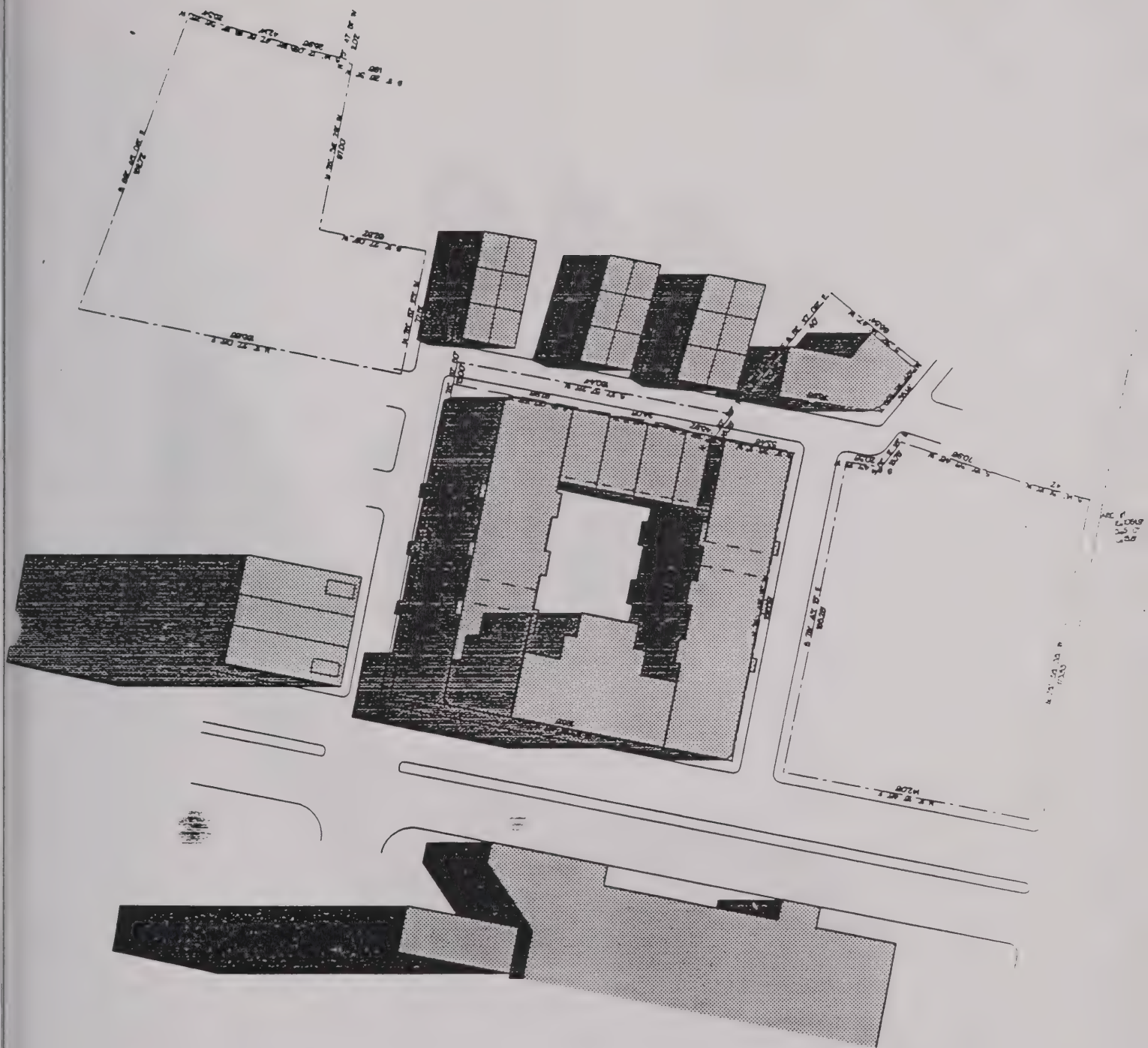
APPENDIX D: SHADOW

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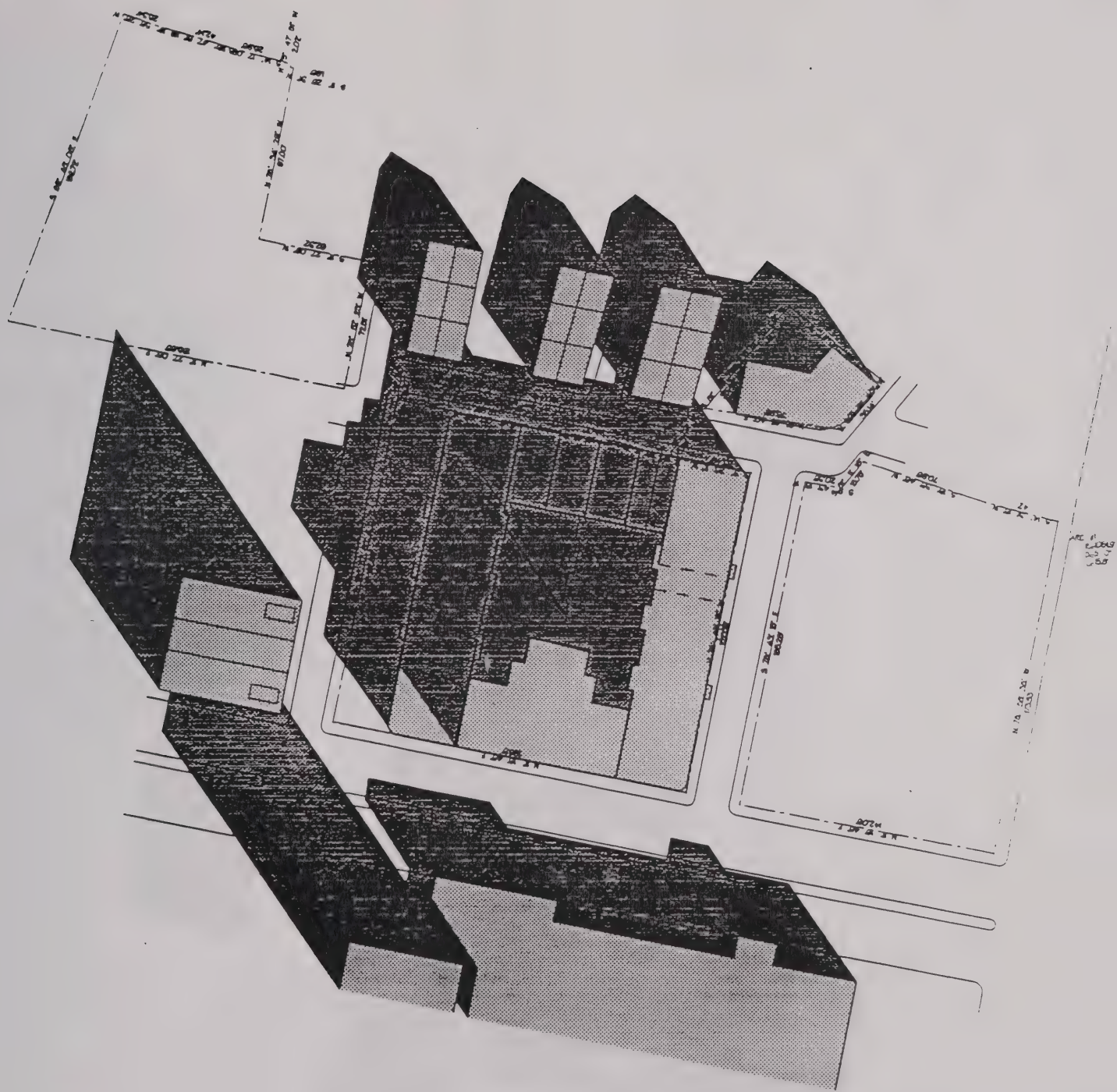
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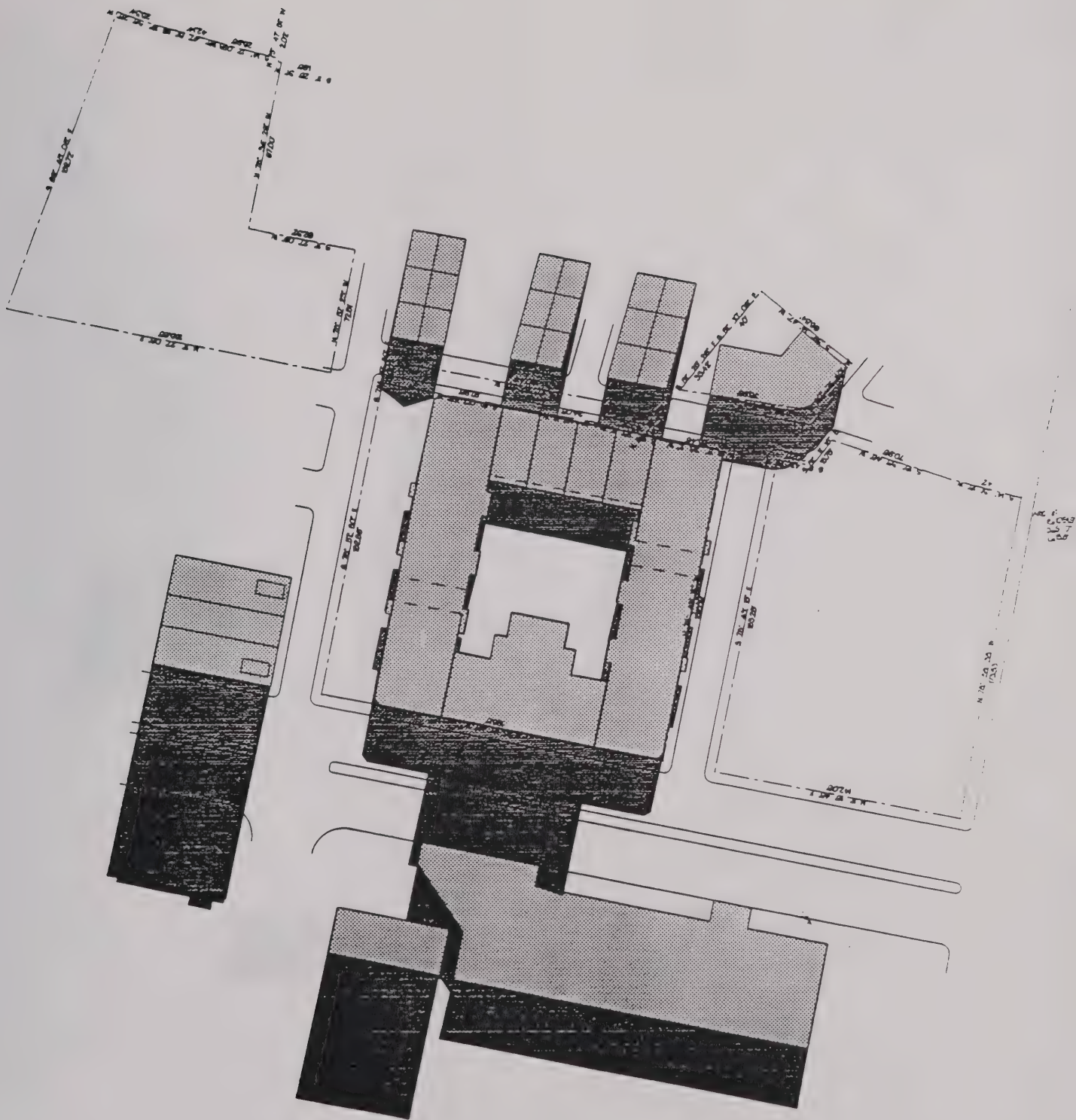
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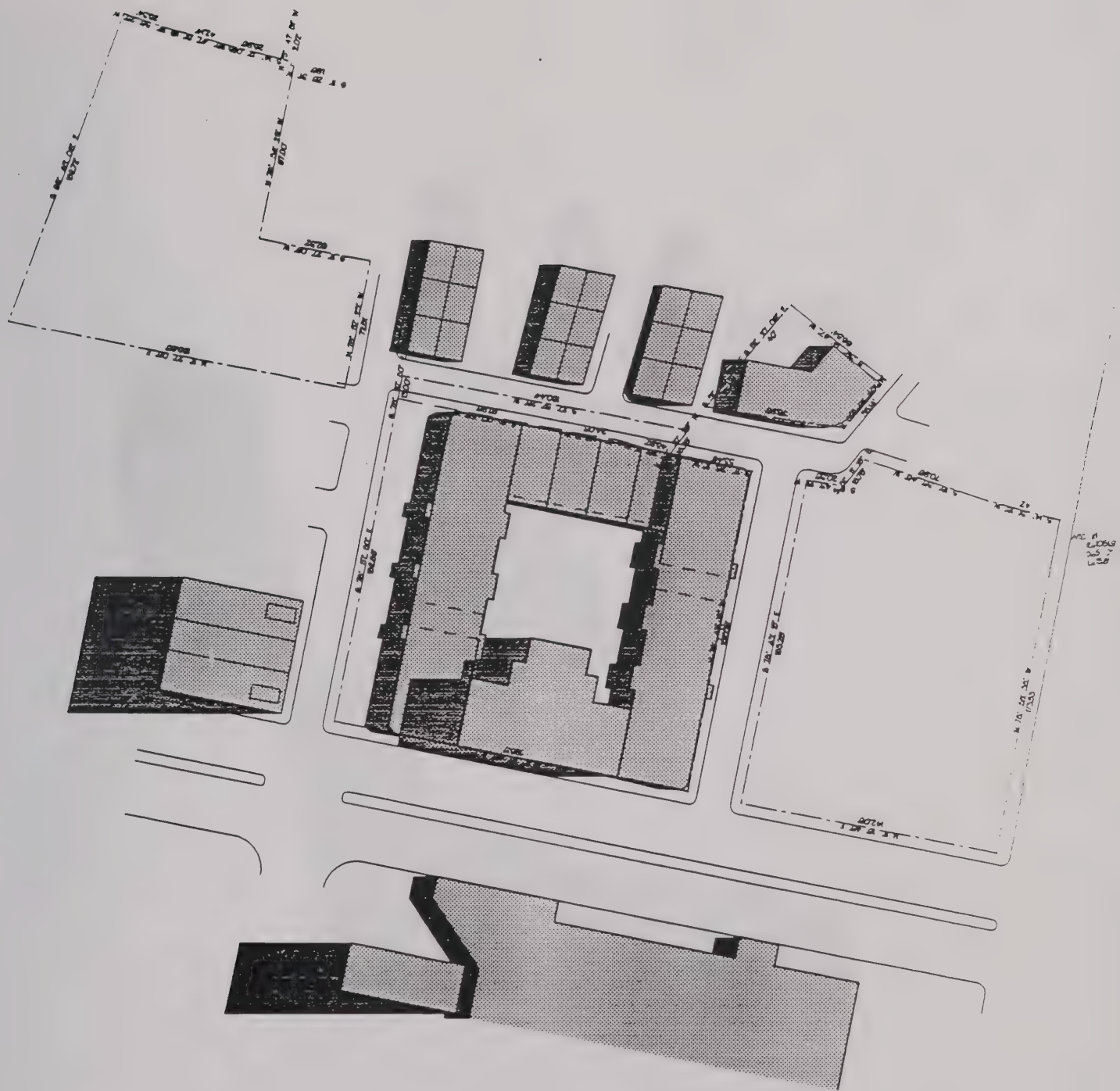
MARCH 21, 3:00 pm





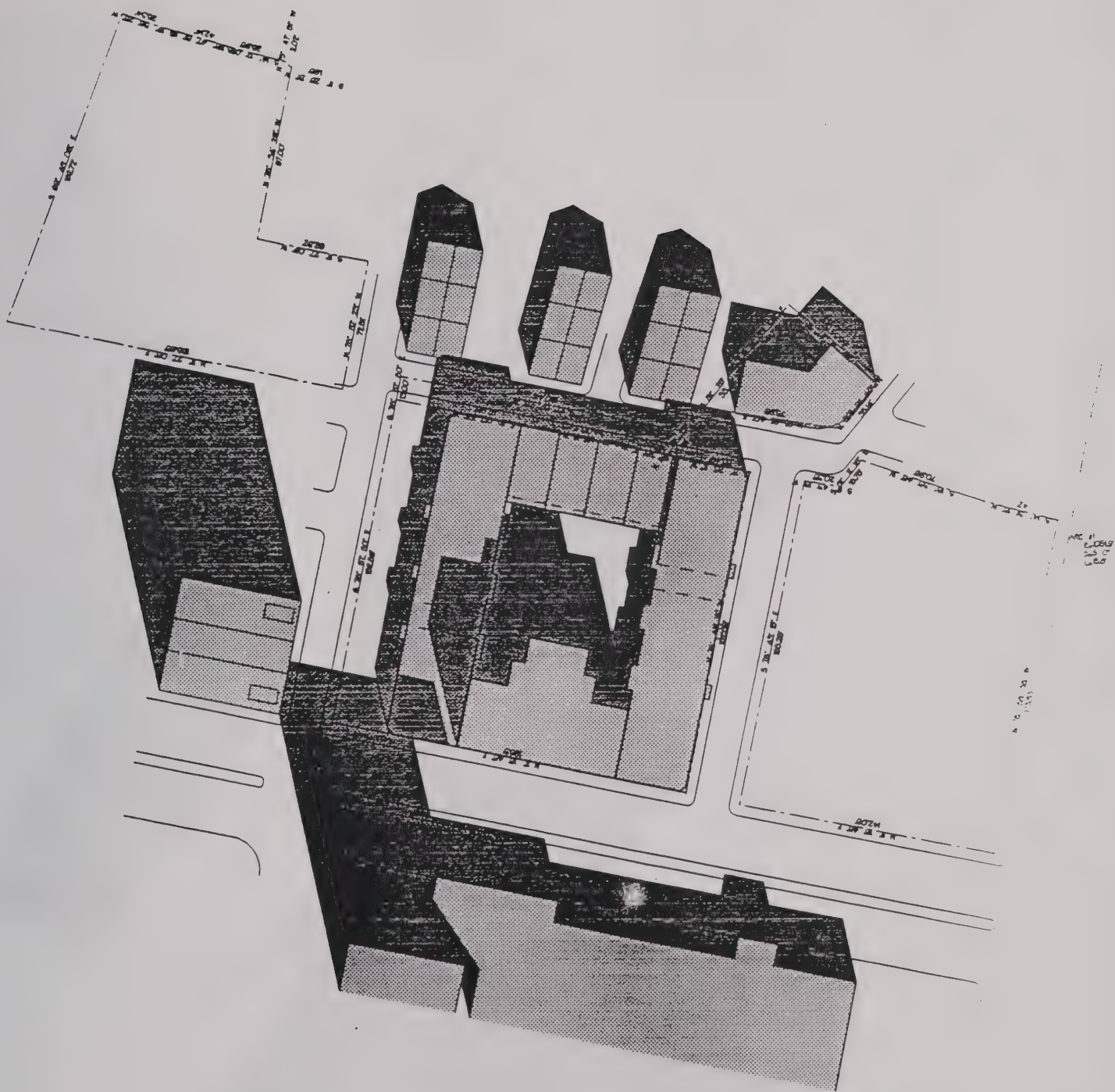
JUNE 21, 9:00 am





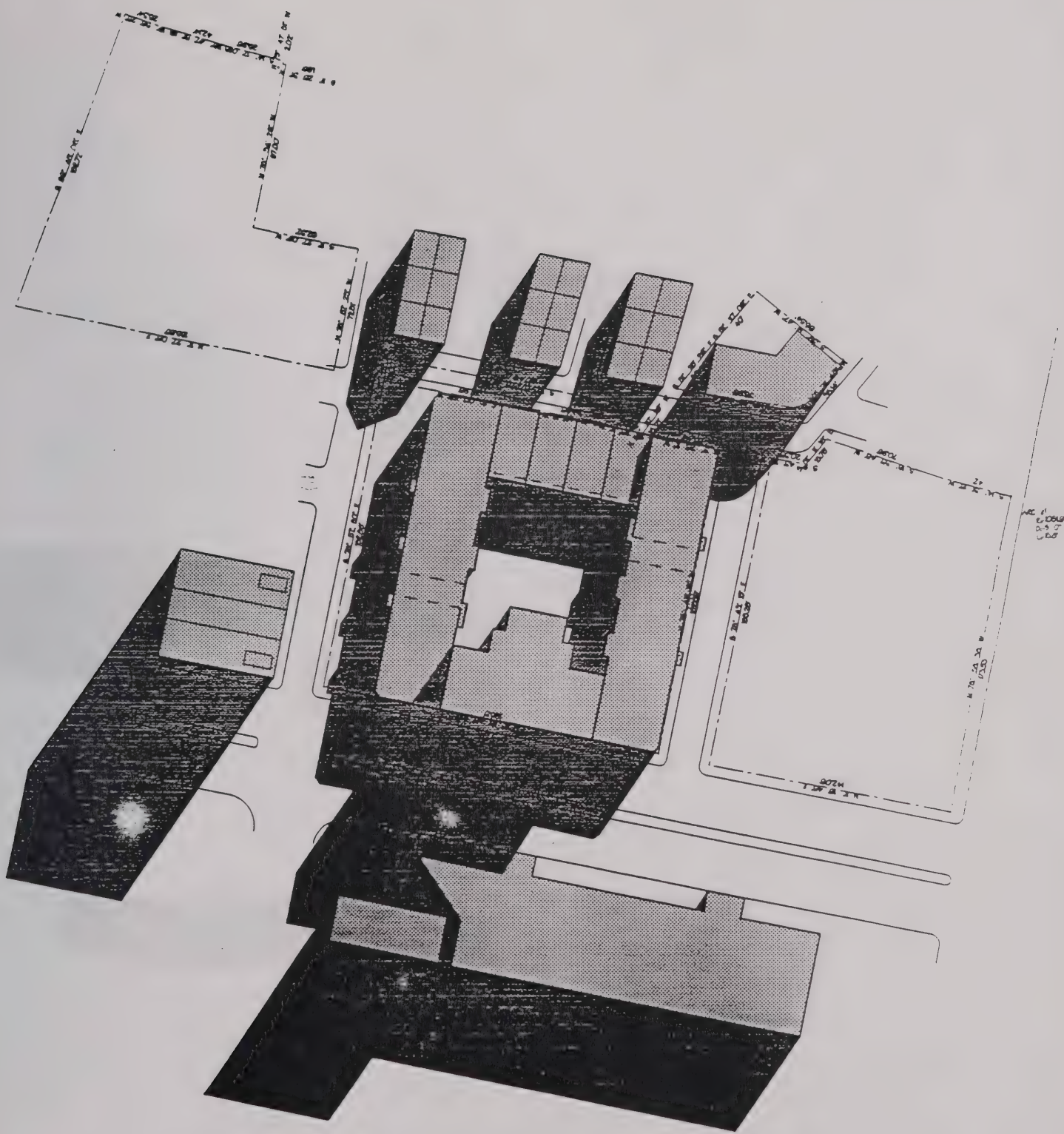
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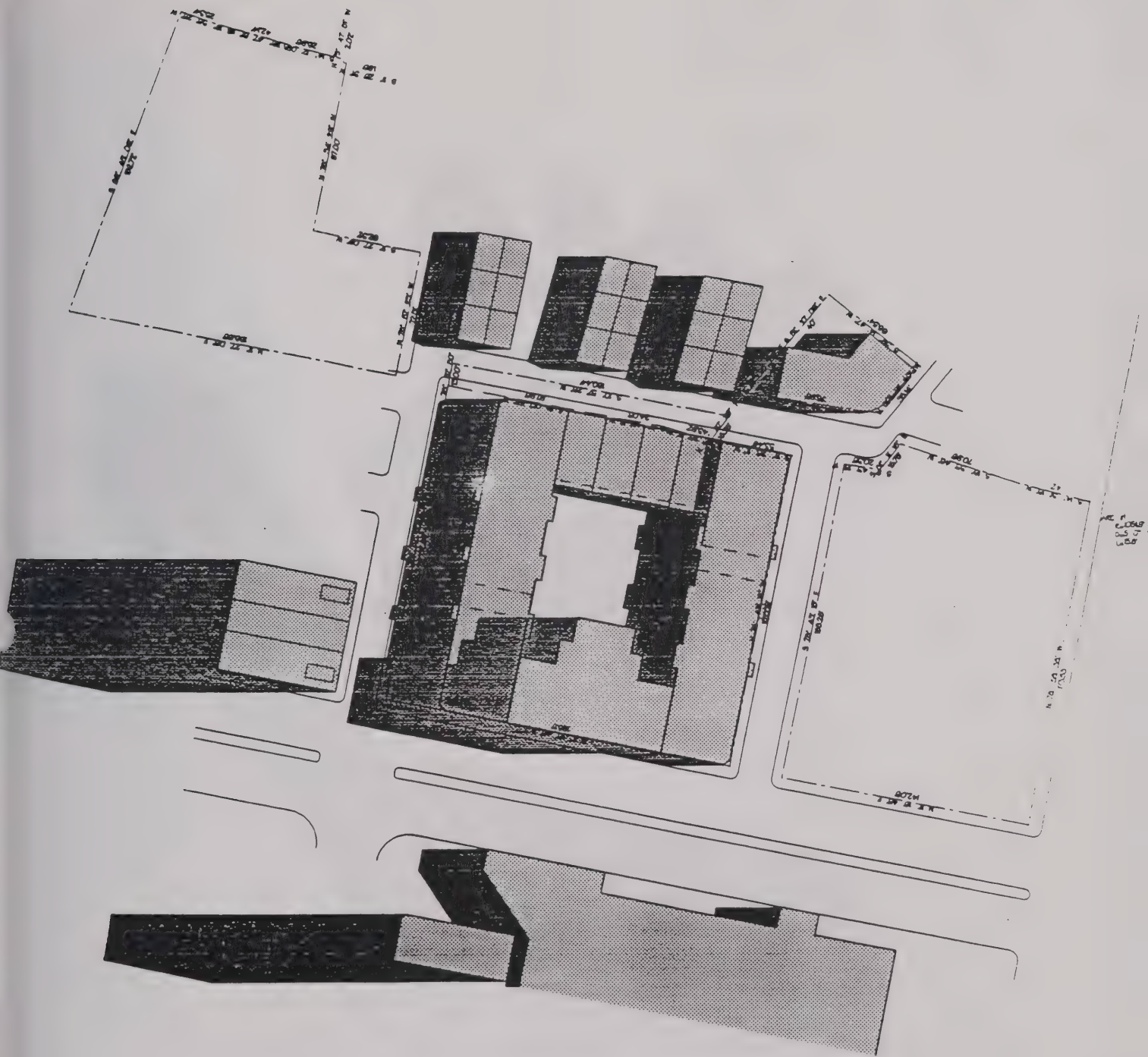
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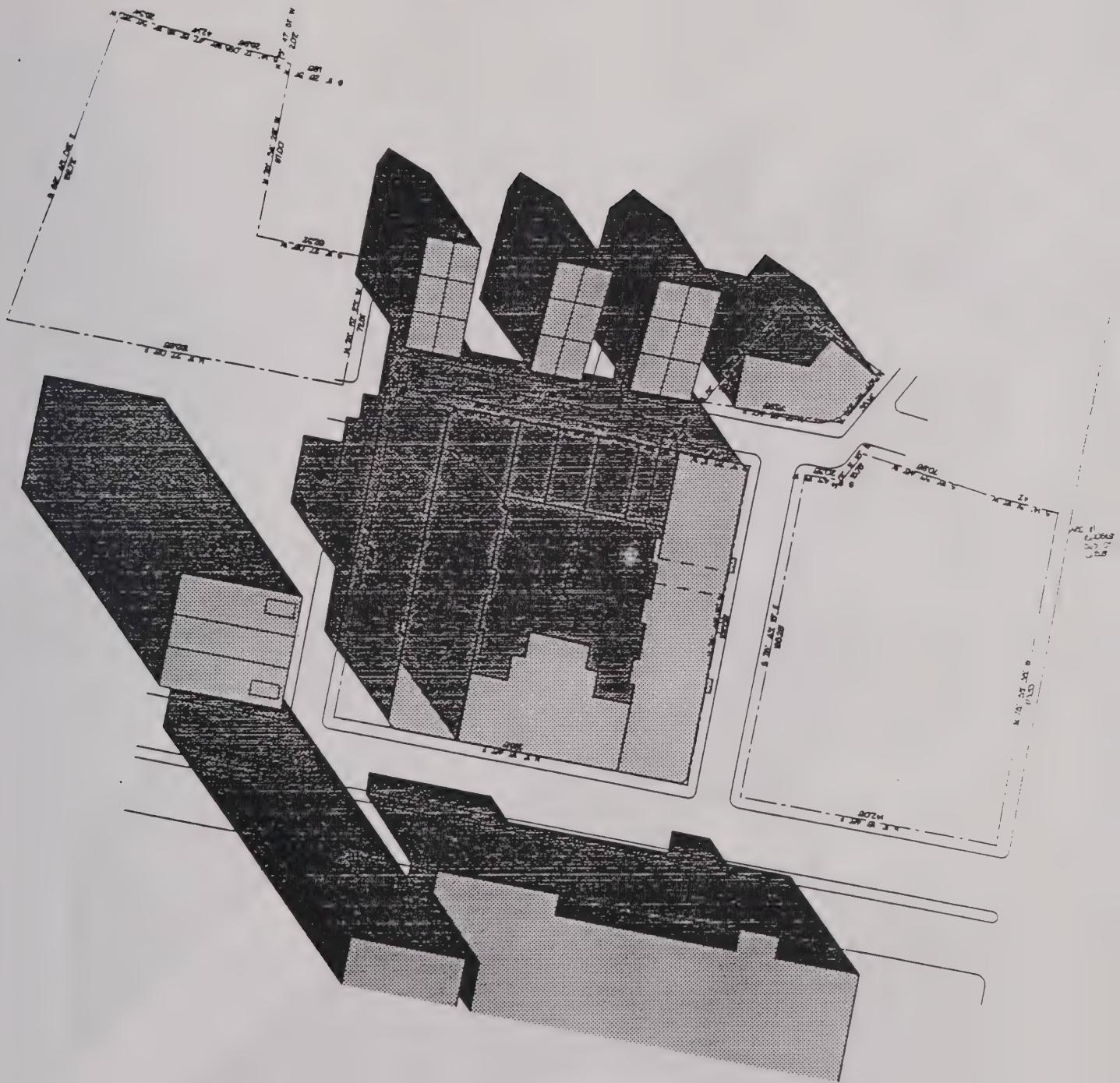
SEPTEMBER 21, 9:00 am





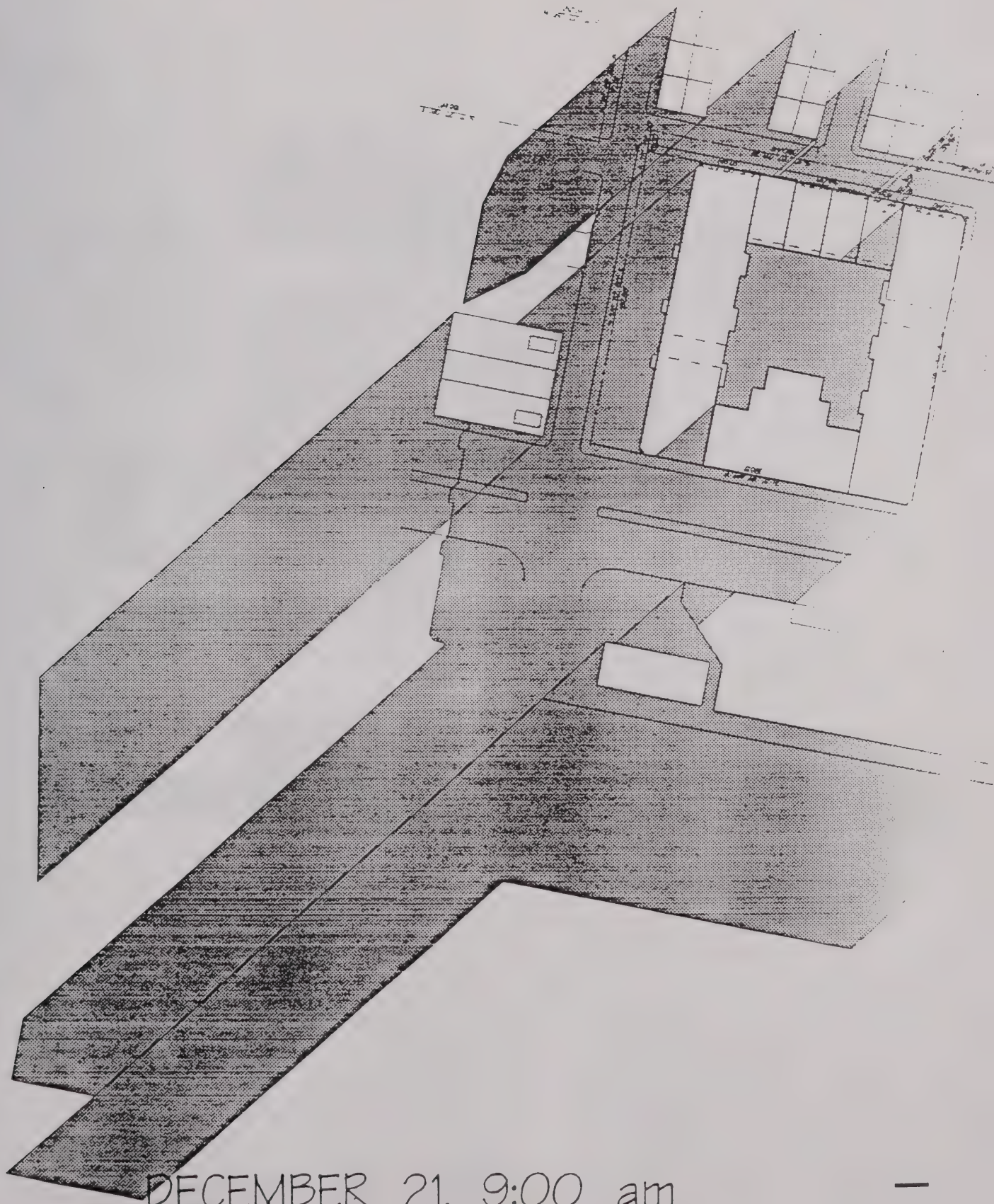
SEPTEMBER 21, 12:00 pm



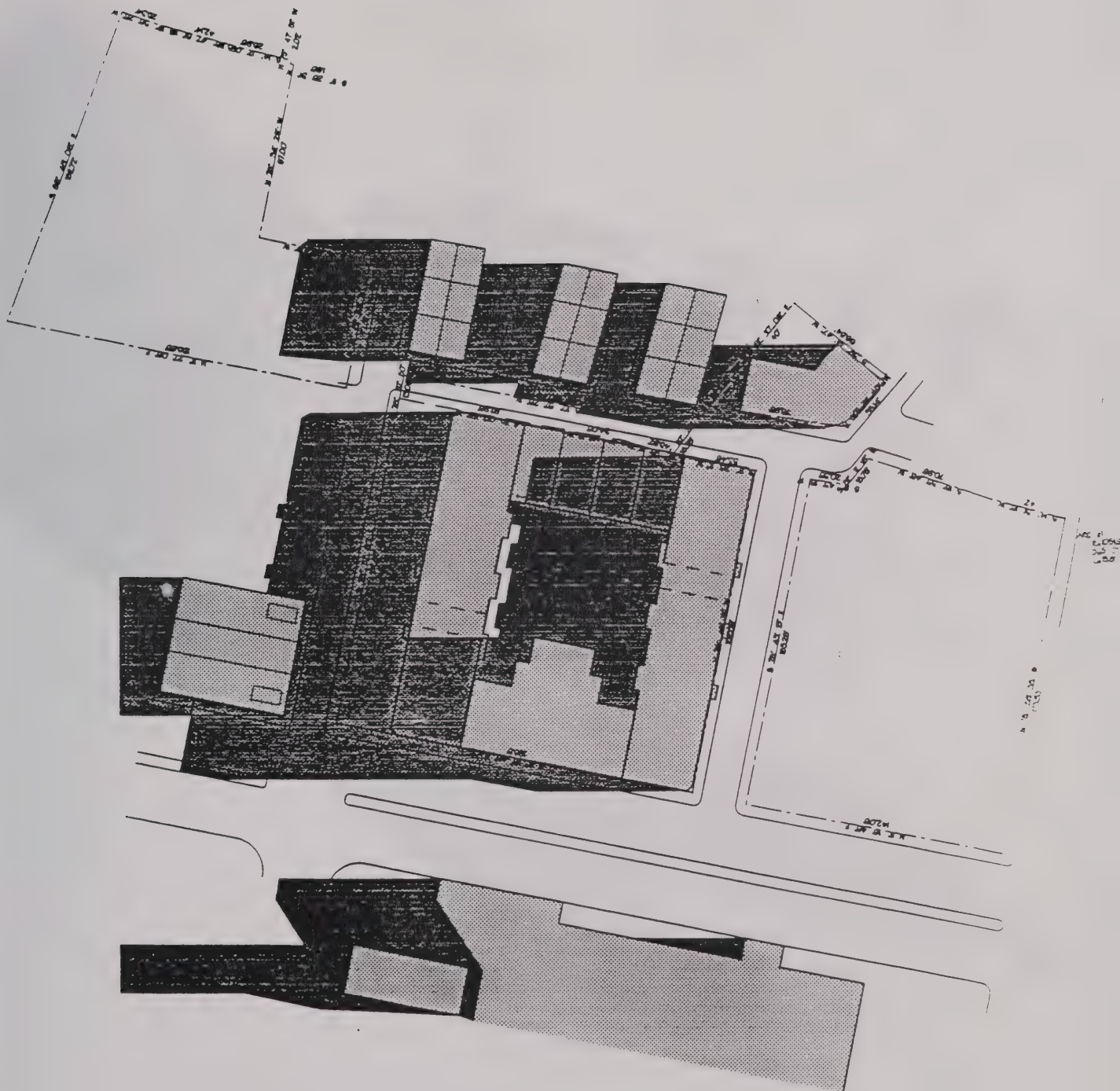


SEPTEMBER 21, 3:00 pm





DECEMBER 21, 9:00 am



DECEMBER 21, 12:00 pm

APPENDIX E: DAYLIGHT

PROJECT DATA

PROJECT NAME : OAK TERRACE

BUILDING LOCATION : WASHINGTON STREET

ARCHITECT / DEVELOPER : LAWRENCE K. CHENG / ASIAN COMMUNITY DEV. CORP.

DATE : 25 MAY 1992

COMMENTS : WEST ELEVATION

SITE CHARACTERISTICS

Width of street : 30

Distance from street edge to front property line : 8

Width of property : 199

BUILDING CHARACTERISTICS

LAYER 1

Distance back from front property line : 0

FROM	DIRECTION	DISTANCE	LAYER COORDINATES		IS NOW
			HORIZ(X)	VERT(Y)	
left prop line	right	69	69	-	-
ground	up	0	69	0	corner 1
corner 1	up	101	69	101	corner 2
corner 2	right	90	159	101	corner 3
corner 3	down	101	159	0	end of layer

LAYER 2

Distance back from layer 1 : 0

FROM	DIRECTION	DISTANCE	LAYER COORDINATES		IS NOW
			HORIZ(X)	VERT(Y)	
left prop line	right	30	30	-	-
ground	up	0	30	0	corner 1
corner 1	up	38	30	38	corner 2
corner 2	right	39	69	38	corner 3
corner 3	down	38	69	0	end of layer

LAYER 3

Distance back from layer 1 : 0

FROM	DIRECTION	DISTANCE	LAYER COORDINATES		IS NOW
			HORIZ (X)	VERT (Y)	
left prop line	right	159	159	-	-
ground	up	0	159	0	corner 1
corner 1	up	38	159	38	corner 2
corner 2	right	39	198	38	corner 3
corner 3	down	38	198	0	end of layer

reflectance

REGION 1 :	SURFACE	AREA	REFLECTANCE
	1	1000	45 %

REGION 2 :	SURFACE	AREA	REFLECTANCE
	1	100	80 %

ball building reflectance 48 %

unadjusted daylight obstruction 79.9 %

reflectance adjusted daylight obstruction 77.3 %

run code 104Mý

APPENDIX F: HAZARDOUS WASTES

1.00 INTRODUCTION

 In accordance with our proposal dated February 10, 1992, GZA GeoEnvironmental, Inc. (GZA) has completed a Phase I - Limited Site Investigation of the BRA Parcels A and B site on Washington Street in Boston, Massachusetts. Our study was completed on behalf of the Asian Community Development Corporation (ACDC) and the Chinese Economic Development Corporation (CEDC).

According to the Massachusetts Contingency Plan (MCP), 310 CMR 40.000, the purpose of the Phase I - Limited Site Investigation is to confirm whether or not the location is a disposal site and, if the site is a disposal site, to provide information necessary for the Massachusetts Department of Environmental Protection (DEP) to classify the site pursuant to 310 CMR 40.544. A Phase I - Limited Site Investigation is not intended to be a comprehensive investigation, but rather an initial study that provides the DEP with the necessary information to classify the site under the provisions of the MCP.

The scope of services included: a site visit; a review of site history; contact with certain local and state officials, and review of certain state and federal files and lists regarding possible environmental concerns at or near the subject site; subsurface explorations in the form of test borings and groundwater monitoring well installations; sampling of soil and the groundwater monitoring wells; limited screening/analysis of the soil and groundwater samples at GZA's Newton Environmental Chemistry Laboratory (ECL) and Matrix Analytical, Inc. of Hopkinton, Massachusetts; and the preparation of this Phase I report.

2.00 BACKGROUND

The following paragraphs describe the physical layout of the site, its hydrogeologic setting and utilities on the site.

2.10 SITE LOCATION

The site is located near the Chinatown section of Boston just to the north of the Massachusetts Turnpike. A site locus is provided as Figure 1, and a site plan is presented on Figure 2. Parcels A and B are both on the east side of Washington Street, and Pine Street extends diagonally to the southeast from Washington Street across both Parcels A and B. Parcel A consists of two lots: Lot R3A2 is

approximately 32,745 square feet, and lot R3A1 is approximately 3,594 square feet. Lot R3A1 and a small portion of lot R3A2 are north of Pine Street, and the larger portion of lot R3A2 is south of Pine Street. Most of Parcel B, which consists of one lot (lot R3B), is north of Pine Street; however, the southwest corner of Parcel B is to the south of Pine Street.

The site is in a mixed residential and commercial neighborhood. Oak Street, beyond which is a parking lot, is to the north of the site, and Washington Street, beyond which is the Josiah Quincy Elementary School, is to the west of the site. Marginal Street, beyond which is a below grade portion of the Massachusetts Turnpike, is to the south of the site. Residences and the Chinese Evangelical Church are to the east of the site. Maple Place abuts the northern portion of the site, and a 28-foot-wide section of property that is labeled as "public" separates a small portion of the study site (lot R3A1) from the main portion of the site (lots R3A2 and R3B). The Tufts/New England Medical Center is approximately 100 feet to the northwest of Parcel B.

Site latitude and longitude coordinates are 42° 20' 48" north and 72° 3' 49" west, respectively. Site Universal Transverse Mercator (UTM) coordinates are 4,690,350 meters north and 329,775 meters east.

2.20 TOPOGRAPHY AND DRAINAGE

According to the U.S. Geological Survey topographic quadrangle map of the area (Boston South Quadrangle, 1979), the site is located approximately 1/2 mile west of Fort Point Channel. Based on a preliminary review of the area's topography and location, and data collected during a groundwater elevation survey, groundwater flow is to the southeast. However, localized flow directions in the vicinity of the site may vary as a result of underground utilities (e.g., storm drains, sewers, utility conduits) or heterogeneous subsurface conditions.

Subsequent references to upgradient or downgradient directions in relation to the site are relative to GZA's anticipated southeasterly direction of groundwater flow.

2.30 SITE DESCRIPTION

Site reconnaissances were performed on Parcels A and B on two dates: June 25, 1991 and February 18, 1992. Photographs of the site are included with the Figures section of this report.

Parcel B is covered by a building, a playground, landscaped land and a former vegetable garden. An abandoned six-story masonry building is along Washington Street. Its interior was observed by GZA geologist Richard Ponti on June 25, 1991; however, the building interior was not observed during our February 18, 1992 site

reconnaissance since the building appeared to have fallen into further disrepair. Most of the building windows were broken or boarded up.

Our June 25, 1991 site reconnaissance indicated that each of the floors contained one staircase and elevator shaft in the central area of the building and one staircase at the rear of the building. Sinks, showers and bathrooms are located on the rear corners of the structure on each floor.



The first floor contained trash, desks, broken video games, a few empty spray paint cans, some automotive paints and one empty 55-gallon drum labeled as a degreaser. The south portion of the building appeared to have been an automotive bay or garage at one time (see Photograph No. 2). Small isolated surficial oil and grease stains were observed on the concrete floor. No floor drains were observed. The southeast corner of the building contained one, approximately 275-gallon aboveground fuel storage tank. GZA could not determine if the tank was still storing a liquid. A 3-foot by 4-foot surficial stain was observed on the concrete floor near the tank. The rest of the floors were wood and contained broken glass, wood debris, broken furniture, printing presses, bench lathes, empty 1-gallon and 5-gallon paint cans, clothing, children's books, toys, records, ceiling tiles and a few mattresses. Each of the sinks and bathrooms were observed, and no evidence of oil or hazardous materials were noted. The sixth floor bathroom pipes appeared to have white fibrous insulation, possibly asbestos, around the pipes.

The basement contained a large boiler and a cinder block containment vault at the southeast corner. GZA did not have access to observe the inside of the vault at the time of the visit. The basement also contained large quantities of wood debris, glass, and broken furniture. Two 4- to 6-inch-diameter pipes adjacent to the ceiling also appeared to contain white fibrous insulation that could be asbestos (It is noted that an asbestos survey of the building was not part of our current scope of work). No evidence of a release of oil or hazardous materials was observed in the building except for the minor floor staining. In addition, white fibrous insulation, possibly asbestos, may be present around a few of the pipes in the basement and the sixth floor.

A small communal garden is on the north portion of the study site, while a landscaped area is on the east portion of the study site. A playground is on the eastern portion of the site, and includes a paved basketball court and various recreational apparatus such as a swing set. GZA did not observe stressed vegetation or significant surficial staining in the landscaped land or playground areas.

Automobile parking areas are on the southern portion of the site. An unpaved gravel parking area, surrounded by a chain link fence, is located south of the playground area on the eastern portion of the site on Parcels A and B. A portion of a paved parking lot is to the south of Pine Street on the southwest portion of Parcel B and most of Parcel A. According to the parking attendant at the paved parking area south of



Pine Street, the unpaved lot is used by employees of the Josiah Quincy School, and the paved parking area is operated by New England Medical Center. Parcel A was occupied by automobiles on paved and unpaved parking areas during the site visits. The portion of Parcel A that is to the south of Pine Street was a paved parking lot, and the portions of Parcel A north of Pine Street were part of an unpaved parking lot. Oil-like stains typically associated with automobile parking areas were observed on the parking lots. A small guard shack was on the paved parking lot to the south of Pine Street on Parcel A. Three catch basins believed to be connected to the a storm drain beneath Pine Street were observed near the east side of the paved parking area to the south of Pine Street.

2.40 SITE UTILITIES

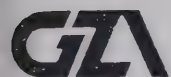
Several utilities are on the site; refer to the utility plan that is attached as Figure 4 for approximate locations of these lines. Underground utilities (water, natural gas, sewer and electric) are located under Pine Street. Abandoned underground telephone lines and water lines enter onto the southwest section of Parcel A's paved lot from Washington Street. The abandoned telephone lines end in the southeast section of Parcel A's main lot, and an abandoned water line ends in the southwest section. According to historical atlases discussed in Section 3.00, a street formerly extended onto the site at this location. Also, in Parcel A's paved lot, a drainage line runs north-south on the eastern section of the parking lot. An abandoned electrical line extends onto Parcel B from Pine Street, and an abandoned telephone line extends into Parcel B from Oak Street. Natural gas, water and electric lines extend onto the northeast section of Parcel B from Oak Street, and natural gas, water, electricity and sewer extend to the abandoned building on the northwest portion of Parcel B from Washington Street.

3.00 HISTORY OF THE SITE

To obtain information regarding the history of the site, GZA contacted the Boston Redevelopment Authority (BRA), Boston Assessor's Office, Building Department, and the Sanborn Mapping & Geographical Information Service of Pelham, New York.

3.10 PARCEL A

Sanborn Maps of the vicinity provided the following information (see Appendix B). An 1867 map indicated that Parcel A was divided into a number of small properties, including two carpentry shops and livery stables. An 1885 map indicates "Protective Department No. 2" at the southeast portion of the site, and a carpentry shop on the northeast portion of the site. Furniture and carpet businesses were also indicated to be on the western portion of the site. An 1895 map indicates a painting shop on the



northeast portion of Parcel A and a stained glass business in the southeast portion of the parcel in addition to several other buildings. As of 1909, there appears to have been dry goods stores and carpentry shops with a blacksmith at the former "Protective Department" location. A 1929 map indicates that the Rufus F. Dawes Hotel extended from the present-day Parcel B into the northeast portion of Parcel A; a Boston Edison substation was located possibly on and/or just to the east of the southeast portion of Parcel A. A 1951 map shows the Dawes Hotel still in place and the remainder of Parcel A still occupied by several small buildings. The former Boston Edison substation was indicated to be occupied by "Electric Motor Rep." A 1989 map shows the site as it is today, occupied by parking. It is apparent that a number of structures which formerly occupied the site were demolished prior to 1989.

Additional historical information was difficult to obtain due to a lack of specific numbered street addresses for the site. Some historical maps indicate portions of the site to be addressed as 664 to 890 to 908 Washington Street, 1-13 Pine Street and 220 to 254 Marginal Street; we believe that these addresses are accurate relative to property lines delineated by BRA Parcel A. The Assessor's Office indicated that the BRA owned property in the area of the site at unspecified numbered addresses on Oak Place, Oak Street and Broadway. No information on past owners of the site was obtained from the Assessor's Office.

The Building Department files indicate that in 1921, a permit was issued for the address of 902 Washington Street to construct a building to house unspecified types of stores. A 1975 Building Department file for 902 and 908 Washington Street was issued to take down a building and fill the property to grade, and 1982 and 1983 permits granted permission for the 902 and 908 Washington Street properties to be used as a parking lot.

According to Mr. Edward Chang of CEDC, the current owners of lot R3A1 and R3A2 are CEDC and the Boston Redevelopment Authority (BRA).

3.20 PARCEL B

The same Sanborn maps were reviewed for Parcel B. The 1867 map indicated that the footprint of the current building was occupied by an armory; the rest of the site appears to have been small commercial properties. The 1885 map indicates that the buildings along Washington Street housed furniture dealers, carpet dealers and a roller skating rink and that the buildings in the northeast portion of the site are labeled "tenements." The 1895 map shows a building on Washington Street partially converted to a Salvation Army hotel and furniture dealers and tenements still present. The 1909 map indicates "elevated railroad tracks" extending behind the Salvation Army hotel. The 1929 map shows that buildings along Pine Street (southeast portion of the site) were replaced by the Rufus F. Dawes Hotel, the Salvation Army is in the Washington Street building, and the elevated railway tracks remain on the site. The

1951 map again shows Parcel B to be covered by several buildings including the Dawes Hotel and that the elevated railroad were still recorded at the site. The 1989 map shows the site to be covered by the present site building, elevated railroad tracks and a playground. All of the historical maps indicate that a street, originally labeled as Ash Street and later as Oak Place, extends onto Parcel B from the north.

Assessor's Office records reviewed in 1991 listed Edward Mascoll, et al. (884 Washington Street) and Samuel James, et al. (888 Washington Street) as property owners. City directories indicate that the building was occupied by a variety of businesses (appliance stores, pawnbrokers, furniture stores) from 1933 to 1978, when it was taken over by the Chinatown Boys Club.

Building Department records indicate that the existing building includes the addresses of 882 to 892 Washington Street. Building permits dating back to 1916 reflect both retail and manufacturing activity as well as several minor structural changes. In 1955, a company called Cambridge Engraving either sold or manufactured signs at 888-890 Washington Street. In 1972 and 1976, permits were issued to the BRA to bring the building up to code standards for the Boys Club of Chinatown. As of 1987, the owner of 882-992 Washington Street was listed as Teradyne Corporation. GZA did not observe any demolition permits in the Building Department records, although the buildings along Pine Street and Oak Street were demolished sometime between 1959 and 1989 according to the Sanborn maps. Additionally, the elevated railway tracks (a portion of the Massachusetts Bay Transportation Authority's "Orange Line") were removed sometime before June 1989.

According to Ms. Carol Lee of ACDC, the Oak Terrace Limited Partnership presently owns Parcel B.

4.00 OIL AND HAZARDOUS MATERIAL USAGE

GZA observed no current use of hazardous materials or oil at the site. However, during our initial site visit, a few small containers of spray paint, automotive paints and an empty 55-gallon drum labeled as a degreaser were observed in the first floor of the building. In addition, the southern section of the first floor that appear to have been formerly used as an automotive bay or garage, and therefore hazardous materials and oil may have been formerly stored and used in this area of the building. Other than minor surficial staining typically associated with parking areas and random rubbish disposal, we did not observe surficial evidence of the presence of oil or hazardous materials on the exterior portions of the site.

5.00 REGULATORY INFORMATION CONCERNING SITE AND VICINITY

Certain state and local agencies were contacted and certain state and federal files and lists reviewed to assess whether hazardous materials may have been released into the soil or groundwater at or near the site. Some of the information was developed by telephone contact; other information is the result of direct interviews and visits. The information made available to GZA during these visits, interviews and file reviews is summarized in the following paragraphs.

5.10 LOCAL

To obtain information concerning the possible release of hazardous material or oil at or near Parcels A and B, GZA contacted the Boston Health, Fire and Water Departments and the Clerk's Office.

The officials at the Fire Department and Clerk's Office indicated that they had no records of underground storage tanks (USTs) at the site. However, please note that GZA was unable to determine how the former site buildings were heated. It is possible that heating oil may have been used to heat the buildings and may have been stored in aboveground or underground storage tanks and not reported to the municipal Fire Department. GZA observed no records of demolition of the site buildings; if storage tanks had been present, it is possible that the tanks may have been left on the site during demolition. In addition, Fire Department records indicated no release of oil or hazardous material at the site. However, Fire Department personnel recalled a gasoline spill on Kneeland Street approximately two years ago.

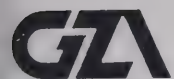
The officials at the Water Department indicated that no public or private water supply wells are at or in the area of the site. In addition, the buildings in the area were indicated to receive their drinking water from the Massachusetts Water Resource Authority (MWRA).

The Health Department officials also indicated that their files indicated no information regarding the storage of hazardous materials or oil at the site.

5.20 STATE

Files made available to GZA at the Massachusetts DEP Northeast Regional Office were reviewed on April 1, 1992.

The DEP Incident Response Files and Spills Database, updated to November of 1991, indicated that 18 spills or releases of oil or hazardous materials have occurred within approximately 1/8 mile of the site:



- Medical Vet. Building, 136 Harrison Avenue: December 4, 1987 spill of various acids and cresol dithiol inside building, no floor drains affected; clean up by Clean Harbors.
- 35 Kneeland Street: 90 gallons of No. 4 fuel oil released during tank test on June 19, 1987; clean up by Clean Harbors.
- Corner of Kneeland and Washington Streets: over 2,000 gallons of cable oil released September 9, 1989 when a contractor jackhammered into cable line; clean up by Clean Harbors.
- Sunoco station located at 976 Washington Street reported two spills of gasoline in 1991; cleaned by Groundwater Environmental Services.
- Atlas Oil, 100 Shawmut Avenue: December 21, 1983 release of 10 gallons of No. 4 fuel oil; clean up by Pollution Control Unlimited (PCU).
- Exxon, Kneeland Street: February 10, 1984 release of 50 gallons of jet fuel; clean up by PCU.
- Tufts University, 136 Harrison Avenue: November 3, 1984 release of 1 gallon of toluene; clean up by Tufts; also December 4, 1987 release of 1/2 to 1 liter of various acids; clean up by Clean Harbors.
- New England Medical Center Hospital, 35 Kneeland Street: June 19, 1987 release of 90 gallons of No. 4 fuel oil; clean up by Clean Harbors.
- BECO, unidentified location on Shawmut Avenue: August 4, 1987 release of unknown quantity transformer oil; no clean up contractor listed.
- Boston University, Harrison Avenue: December 14, 1987 release of unknown quantity of unknown chemicals; clean up by Advanced Em. Tech. Company.
- MBTA, 500 Broadway: July 27, 1990 release of unknown quantity of medical waste; clean up by Clean Harbors.
- Boston Edison, corner Tremont and Kneeland Streets: September 19, 1989 release of 1,000 gallons of cable oil; clean up by Clean Harbors; also, October 31, 1989 release of unknown quantity of cable oil at unspecified address on Kneeland Street; clean up by Clean Harbors.
- Unidentified location on Kneeland Street: September 23, 1989 release of unidentified quantity of gasoline; clean up by Fire Department/Department of Public Works (DPW).

- Munson Transport, unlisted address on Kneeland Street: July 7, 1990 release of unknown quantity of diesel fuel; no clean-up contractor listed.
- Boston Herald, 300 Harrison Avenue: May 31, 1989 release of unknown quantity of gasoline/diesel fuel; clean up by Zecco, Inc.

Most of the reported quantities spilled are relatively small, and clean-up contractors were generally retained to clean up the spills; it is GZA's opinion that the spills listed above are unlikely to have had an adverse impact on the study site.

The DEP January 15, 1992 "List of Confirmed Sites and Locations To Be Investigated" (LTBI) identified two confirmed sites and an LTBI within 1/8 mile of the study site. Discount Fuel located at 739-745 Washington Street is listed as a confirmed site with a Phase 3 status, and New England Medical located at 810-864 Washington Street is listed as a confirmed site with a Phase 2 status. The Discount Fuel site is approximately 1/8 to 1/4 mile northwest and possibly upgradient of the study site; the New England Medical site is across Oak Street from Parcel B. New England Medical is a waiver site, in which the DEP has authorized a private party to proceed with cleanup actions without further DEP oversight. A Sunoco station located at 976 Washington Street is listed as an LTBI with preliminary assessment status. The Sunoco station is approximately 1/8 to 1/4 mile southwest and not upgradient of the study site.

The DEP February 6, 1992 Northeast Regional Sites Database indicated, along with the three previous sites, Boston Herald located at 300 Harrison Avenue and Waterford Place at 180 Shawmut Avenue as reserved sites with preliminary assessment status. A reserved site is an LTBI of lower priority than those included on the DEP's published list. Boston Herald is approximately 1/8 mile southwest and not upgradient of the study site.

The DEP Site Assessment files regarding the New England Medical Center (previously an MBTA station) indicated that fill samples were found to contain elevated levels of total petroleum hydrocarbons (TPHs), polynuclear aromatic hydrocarbons (PAHs), and metals. The waiver application filed for the New England Medical Center site indicated that the likely remedial response action would consist of excavation and removal of contaminated fill.

Site Assessment files for the Boston Herald site contained a letter dated July 12, 1989 from Metcalf & Eddy Technologies, Inc. of Northborough, Massachusetts to the Department of Environmental Quality Engineering (DEQE; now DEP). The letter indicated that free phase weathered petroleum product was discovered during the excavation of two 20,000-gallon fuel oil tanks near the northeast corner of the Herald building. The product was pumped from the ground using a vacuum truck, and contaminated soil was stockpiled on polyethylene sheeting. Eight monitoring wells

were installed; free product was reported in two wells. The letter indicated that a Phase I - Site Investigation report was forthcoming; GZA did not find this report in DEP files.

DEP site assessment files for the Waterford Place site at 180 Shawmut Avenue contained a report by Briggs Associates, Inc. of Rockland, Massachusetts, dated August 9, 1989. The Briggs report indicate that a localized area of stained soil was encountered during excavations for pile caps for a new building. Approximately 100 cubic yards of the stained soil was excavated and stockpiled. Subsequent analysis of the soil by Briggs indicated the presence of less than 100 parts per million (ppm) TPH in the samples analyzed. No volatile organic compounds (VOCs) were detected. The source of the oil was believed to be a crushed heating oil tank which was buried in place when a former building at the site was demolished in the early 1970s. The Briggs report stated that the stained soil was to be disposed of by BFI, Inc. at Northern Disposal Company in East Bridgewater, Massachusetts pending BFI's analysis of the material. DEP files also contained a Bill of Lading indicating that approximately 150 cubic yards of contaminated soil was removed from the 180 Shawmut Street property to GCR in Peabody, Massachusetts on August 11, 1989.

GZA also reviewed the DEP Water Supply Protection Atlas, which did not indicate the presence of the following potential sources of environmental contamination within 1/4 mile of the study site; landfills, salt storage sites, surface impoundments, junkyards or hazardous waste sites. The Atlas additionally indicated no public water supply wells or reservoirs within 1/4 mile of the site.

5.30 FEDERAL

GZA reviewed the March 3, 1992 Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) list of hazardous waste generators, transporters and treatment/storage/disposal facilities registered under the RCRA. This list identified ten such companies within approximately 1/8 mile of the study site; of these, eight were listed as small quantity generators and two (New England Medical Center and Tufts University Medical School) were listed as large quantity generators. The hazardous waste generators in the vicinity of the subject site are listed in Table 1.

The EPA March 4, 1992 Facility Index System (FINDS) list of companies involved with any of 12 EPA monitoring programs included ten companies within approximately 1/8 mile of the study site; these companies are also listed on Table 1. All of the companies are included under the Hazardous Waste Data Management System (RCRA information) but the FINDS list includes three companies which were listed on the RCRA list, and does not include three other companies which were listed on the RCRA list.

The March 4, 1992 Comprehensive Environmental Response, Compensation and Liability Act Information System (CERCLIS) list of sites for possible investigation under the Federal Superfund program indicated no listings within 1/8 mile of the study site. EPA's February 25, 1992 National Priority List of Federal Superfund sites in Massachusetts did not include any sites in Boston.

Additionally, the 1981 and 1986-1992 EPA lists of companies with National Pollutant Discharge Elimination System (NPDES) permits were reviewed. They showed no companies in the vicinity of the site with NPDES permits.

EPA's Emergency Response Notification System (ERNS) list dated February 24, 1992 of spills reported to the EPA did not indicate any spills reported at or within 1/8 mile of the study site.

6.00 FIELD EXPLORATION, SAMPLING AND ANALYTICAL PROGRAM

GZA completed a field exploration program as part of the present evaluation to assess the presence of oil or hazardous materials in soil and groundwater at the site. This program consisted of the execution of a total of 19 borings (10 on Parcel A and nine on Parcel B), the installation of 14 monitoring wells (seven on each parcel), and the collection and screening analysis of soil and water samples.

To the extent feasible, initial (June 1991) exploration locations were selected to obtain soil and groundwater samples from generally upgradient and downgradient areas of the site. Boring locations were also selected so as to provide geotechnical information for the proposed site development. Locations of the borings completed during the second phase (February 1992) of exploration were selected based on the results of the initial field work. These were intended to provide additional soil and water samples for more comprehensive chemical analyses in areas of suspected contamination and to provide additional site coverage. An Exploration Location Plan is attached as Figure 2.

Similar field procedures and analytical techniques were used for both parcels, and the types of subsurface materials encountered on the two parcels were similar. Therefore, a general discussion of field procedures and geologic conditions encountered, pertaining to both parcels, is presented below. Results of the chemical analyses of soil and groundwater samples are discussed separately by parcel.

6.10 SUBSURFACE EXPLORATIONS AND MONITORING WELL INSTALLATIONS



Between June 4 and 28, 1991, 14 borings (GZA-1 through GZA-8 and GZB-1 through GZB-6) were completed by GZA Drilling, Inc. of Brockton, Massachusetts. Five additional borings (GZA-9 through GZA-13) were completed by GZA Drilling on February 24, 1992. Hollow stem auger techniques were employed without the use of water or other drilling fluids for shallow borings. Some of the June 1991 borings were advanced to greater depths (up to 107 feet) to provide geotechnical data for building foundation design. These deep borings were advanced using drive and wash methods through the overburden and a diamond bit with NX core in bedrock.

A monitoring well consisting of 10 to 15 feet of 1.5-inch-diameter PVC wellscreen attached to a solid PVC riser pipe was installed in 14 of the borings. All PVC attachments were completed without the use of solvents or glues to prevent contamination. The wellscreen was set to span the water table encountered in the boring during drilling. A filter of clean silica sand was placed in the annular space around the wellscreen, and a bentonite clay seal was placed above this filter sand. Each well was completed with a curb box at the ground surface. Well installation details are presented on the boring logs in Appendix C.

6.20 SOIL AND WATER SAMPLING

Split spoon samples were obtained by Standard Penetration Tests at 5-foot intervals during the drilling operations. Soil samples were classified by the on-site geologist; boring logs developed by GZA are attached as Appendix C. A portion of each soil sample was collected in a clean glass jar, stored in an ice-packed cooler and transported under chain-of-custody procedures to GZA's Environmental Chemistry Laboratory (ECL) for chemical screening. In addition, two surface soil samples were collected from the site on March 23, 1992.

On June 19-29, 1991 and February 24 and March 3, 1992, GZA personnel sampled the monitoring wells at the study site. Groundwater samples were obtained using 5-foot stainless steel bailers with Teflon ball check valves. A separate laboratory-cleaned bailer was used for each well to avoid cross contamination. Three times the initial standing volume of the groundwater in the well was evacuated to remove stagnant water, and the well was allowed to recharge. Water samples were collected in hydrochloric acid preserved 40-ml vials with Teflon septa, 1-liter amber jars, and in 8-ounce glass jars. The samples were kept cool and delivered under chain-of-custody procedures to GZA's ECL.

GZA measured water levels in each monitoring well with an electronic water level reader at the time of sampling. The depths to water table are indicated on the well logs in Appendix C.

6.30 GROUNDWATER FLOW DIRECTION MEASUREMENTS

To estimate the direction of site groundwater flow, GZA conducted an elevation survey on March 3, 1992 using laser level techniques and a local benchmark (a bolt on a fire hydrant as shown on Figure 3). GZA surveyed the well casing elevations and measured the depths to groundwater in the wells. The water levels in the wells are presented on Table 2 and on the boring logs in Appendix C. Groundwater elevations were calculated by subtracting groundwater depths from the wellhead elevations. Survey data and relative groundwater elevations are provided on Table 2, and a groundwater contour plan is provided as Figure 3.



6.40 CHEMICAL SCREENING OF SOIL AND WATER SAMPLES

Soil samples collected from the site were screened in GZA's ECL for total VOCs using an H-Nu Model PI-101 photoionization detector (PID) with a 10.2 electron volt lamp. The PID measures relative levels of VOCs referenced to a benzene in air standard. Although the PID screening cannot be directly used to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator of the levels of VOCs in each sample. Laboratory PID screening results are presented on the boring logs in Appendix C, and summarized in Tables 3 and 6. A discussion of the results of the screening analyses is provided in Section 7.20.

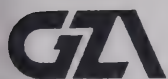
Based on PID screening results, additional chemical screening by static headspace gas chromatograph (GC) techniques was performed on selected soil samples using a Hewlett Packard Model 5890A GC. The GC screening analysis permits the tentative identification and approximate quantification of individual VOCs. GC screening results and a description of GZA's GC screening procedures for soil are included in Appendix D; results are discussed in Section 7.20 and presented in Tables 4 and 7.

Water samples were also screened for VOCs using the GC and static headspace techniques. The GC screening procedures and results are presented in Appendix D; results are discussed in Section 7.20 and presented in Tables 5 and 8.

In addition, water samples were screened for pH and specific conductance within 24 hours of collection. The pH is a measure of the acid or basic nature of water, and specific conductance is a measure of dissolved ions in water. An Orion Research Model EA 940 Expandable Ionanalyzer was used to measure pH and an YSI Model 34 Conductivity Meter was used to measure specific conductivity. Results are presented in Tables 5 and 8 and discussed in Section 7.20.

Selected soil and groundwater samples were analyzed for TPH content by infrared (IR) spectroscopy, and additional analyses for petroleum hydrocarbons (PHCs) were conducted using GC techniques using modified ASTM Method D-3328. Selected water and soil samples were also screened at GZA's ECL for semi-VOCs. One

composite soil sample from each site was submitted for broad spectrum chemical analyses which included PCBs by EPA Method 8080 (GZA ECL) and toxicity characteristic leaching procedure (TCLP) for metals, pesticides and herbicides by Matrix Analytical, Inc. of Hopkinton, Massachusetts . The analytical procedures and results are included in Appendix D; results are discussed in Section 7.20 and summarized in Tables 4, 5, 7, and 8.



7.00 FIELD EXPLORATION AND ANALYTICAL RESULTS

The following sections summarize the soil conditions encountered as well as the results of chemical screening of soil and water.

7.10 SUBSURFACE CONDITIONS

Soil conditions are summarized from the boring logs attached as Appendix C. Each of the borings encountered between 6 and 17 feet of granular fill overlying silts and clays. Borings GZA-2, GZA-4, GZB-1 and GZB-3 were advanced approximately 10 to 16.5 feet into bedrock. These borings encountered glacial till at depths ranging from approximately 71 to 87 feet below ground surface; the thickness of the till ranged from approximately 4 to 12 feet. The depth to bedrock ranged from approximately 75 feet (GZA-4) to 94.5 feet (GZB-1) below existing grade.

7.20 GROUNDWATER FLOW

Results of our groundwater elevation survey (Figure 3) indicate that groundwater flows to the southwest toward the subgrade section of the Massachusetts Turnpike and Fort Point Channel. The difference in the elevation of the watertable on the site is approximately 5 feet; the lowest watertable elevation is in well GZA-13, which is on the southeast portion of the site. Depths to groundwater ranged from approximately 6 to 13 feet based on our March 1992 measurements.

7.30 RESULTS OF CHEMICAL SCREENING ANALYSES

Results of chemical screening and analyses of soil and groundwater samples from Parcels A and B are summarized below. Laboratory reports are contained in Appendix D.

7.31 Parcel A

A total of 84 soil samples and 13 groundwater samples (six from the June 1991 sampling round and seven from the February/March 1992 sampling round) were

collected for chemical screening and analysis; results are described below and summarized in Tables 3, 4, and 5.

Soil

PID readings did not indicate detectable levels of VOCs (no positive meter response) in 71 of the 84 soil samples collected from Parcel A (Table 2). PID readings ranging from 0.1 to 1.8 ppm in nine of the 13 samples which registered a positive meter response. GZA considered these readings to be within the background range typically encountered in urban areas. Slightly elevated PID readings (2.8 to 8.2 ppm) were reported in samples GZA-2, S-5; GZA-4, S-1 and S-2; and GZA-5, S-3. With the exception of GZA-2, S-5, all of these samples were collected from fill materials.

The three samples which indicated slightly elevated PID readings and eight other samples were screened for VOCs using static headspace GC techniques. VOCs were reported in four of these samples at levels close to the detection limit of the method employed. Specific compounds reported included methyl-t-butyl ether, toluene, ethyl benzene and xylenes. These compounds are common constituents of petroleum products, such as gasoline. Unknown compounds which may be other petroleum-related hydrocarbons were also reported in samples from GZA-4, GZA-5 and GZA-8.

Based on the PID screening data, 11 soil samples were analyzed for TPH by IR methods; TPH concentrations ranged from 18 to 5,400 ppm (Table 3). Two individual samples (GZA-11, S-4 and GZA-13, S-2) and two composite samples (composite A consists of samples S-1, S-2 and S-3 from GZA-11 and samples S-1 and S-2 from GZA-13, and Composite 1 consists of samples S-1 and S-2 from GZA-13) were analyzed for PHCs by GC methods; results ranged from 53 to 440 ppm. TPH IR methods are subject to a number of interferences which can artificially elevate measured PAH concentrations. Accordingly, we believe that the GC results more accurately reflect conditions at the site.

The samples screened for PHCs were also screened for semi-volatile organic compounds. A number of polycyclic aromatic hydrocarbons (PAHs) were reported, at total concentrations ranging from 5.9 to 82 ppm. PAHs are byproducts of coal combustion and automobile exhaust and are commonly found at similar concentrations in urban fill. No other semi-volatile organic compounds were detected.

Composite A was analyzed for total lead content; 265 ppm of lead was detected. While this concentration is slightly elevated compared to natural background levels, it is within the range commonly observed in urban areas. Sources of lead in urban soils include automobile exhaust and lead paint chips.

Composite A was also submitted for TCLP analysis for metals, pesticides and herbicides. The metals results indicated a barium concentration of 0.430 ppm, and a lead concentration of 0.230 ppm in the sample leachate; these concentrations are below applicable standards for these metals. None of the remaining six metals analyzed were detected, and no pesticides or herbicides were reported.

GZA's laboratory analyzed Composite A for PCBs by EPA Method 8080; none were detected.

Groundwater

No VOCs were detected in GZA's GC screening of the six groundwater samples collected from Parcel A in June 1991, with the exception of five unknown compounds in the sample from GZA-4 (Table 5). This sample was submitted for TPH-IR analysis; the TPH level was below the detection limit for the technique employed (1 ppm).

No VOCs were detected in four of the seven groundwater samples collected in March 1992. Four unknown VOCs were reported in sample GZA-4. Six unknown VOCs and 36 parts per billion (ppb) of toluene were detected in sample GZA-11, and a trace of m,p-xylenes and 22 unknown compounds were detected in sample GZA-13. Toluene and xylenes are common constituents of petroleum products, such as gasoline and diesel fuel. Unknown compounds reported in these samples may also be petroleum-related hydrocarbons.

PHC analysis of samples GZA-2, GZA-4 and GZA-13 did not indicate the presence of PHCs in any of the samples above the 0.5 ppm method detection limit.

Samples GZA-4, GZA-11 and GZA-13 were screened for semi-VOCs; none were detected with the exception of the PAH compounds benzo-a-anthracene and chrysene in GZA-11; both were present at concentrations below the minimum quantification level (BMQL) of the screening procedure (0.005 ppm).

The pH of the groundwater samples ranged from 6.6 to 8.8. The higher pH readings may be associated with concrete in the fill material. Specific conductance ranged from 596 to 5,540 μ mhos/cm. These readings are elevated for New England groundwater but are within the ranges commonly observed at urban sites. Elevated conductance may be related to the impact of residual amounts of brackish water due to the marine origin of site sediments.

7.32 Parcel B

A total of 92 soil samples and nine groundwater samples (four from the June 1991 sampling round and five from the February/March 1992 sampling round) were collected from Parcel B.

Soils



PID screening did not indicate detectable levels of VOCs in 59 of the 92 soil samples (Table 5) from Parcel B. PID readings of approximately 2 ppm or less were reported in 27 of the 33 samples in which VOCs were detected; GZA considers these levels to be within the background range typically observed in an urban area. Readings between 6.8 and 65 ppm were detected in soil samples GZB-1, S-2 and S-3; GZB-3, S-2; GZB-5, S-5 and S-6; and GZB-6, S-3. With the exception of the samples from GZB-5, all of the elevated VOC readings were observed in samples from the fill.

Based on the PID readings, 10 soil samples were selected for GC screening. With the exception of the samples from GZB-3, none of the 23 common VOCs identified by GZA's GC screening technique were identified in the samples. Trace levels of toluene, ethyl benzene and xylenes (compounds often associated with petroleum products) were detected in GZB-3, S-1 and S-2. Unknown VOCs were reported in all of the samples except GZB-4, S-5. Trace to moderate levels of late eluting compounds were detected in GZB-2, S-1; GZB-3, S-1; and GZB-5, S-5 and S-6. Trace to high levels of variously eluting compounds were detected in GZB-1, S-1, S-3 and S-4. The pattern of the chromatogram for GZB-6, S-3 indicates the presence of an unknown petroleum distillate such as fuel oil.

Based on the GC and PID screening results, 13 soil samples were submitted for TPH-IR analysis (Table 7). The results indicated TPH levels between 75 ppm and 1,500 ppm for soil samples GZB-1, S-2, S-3; GZB-2, S-1, GZB-3, S-1, S-2; GZB-5, S-6; and GZB-3, S-3; non-detectable levels of TPH were reported samples GZB-1, S-4; GZB-2, S-3; GZB-3, S-3 and S-18; GZB-4, S-5; and GZB-5, S-5. Four soil samples including two composite samples were analyzed for PHCs by GC methods; PHC concentrations ranged from 280 to 830 ppm. The PHC concentrations in the composites were lower than those measured in individual samples. Composite 2 consists of samples GZA-9, S-1 and GZA-10, S-1, while Composite B consists of the S-1 samples from borings GZA-9, GZA-10 and GZA-12. PHCs from the February 1992 soil samples were qualitatively identified as components of a product in the fuel oil No. 6/asphalt boiling range.

The samples submitted for PHC analysis were also screened by GZA for semi-volatile organic compounds. The screening indicated the presence of a number of PAHs at total concentrations ranging from 1.1 to 68 ppm. As noted previously,

PAHs are commonly found at similar concentrations in urban fill. No semi-volatile organic compounds other than PAHs were detected.

Results of analysis of Composite B for total lead indicated a lead concentration of 245 ppm; while slightly elevated above natural background levels, this concentration is not unusual for an urban area.

TCLP analysis of Composite B for metals did not indicate the presence of seven of the eight RCRA metals above the method detection limit. Barium was reported at a concentration of 0.46 ppm; this concentration is below the applicable standard for barium. No pesticides or herbicides were detected.

GZA's PCB screening of Composite B indicated the presence of 0.012 of PCB Aroclor 1260. This level is just above the method detection limit of 0.01 ppm.

Groundwater

The pH of the groundwater ranged from 6.6 to 8.1 (Table 7), which is within the normal range for groundwater in New England. The conductivity ranged between 561 and 3,120 $\mu\text{mhos/cm}$, which is elevated high for New England groundwater. However, based on the urban setting and the marine origin of most of the sediments, the high conductivities may be due to residual salt water trapped within the sediment or road salting practices.

Identifiable VOCs were not reported in samples collected in June 1991 analyzed by headspace GC techniques. However, in a sample from well GZB-1, the results indicated trace to low levels of eight early and late eluting compounds. Based on the VOC screening results, a duplicate sample from GZB-1 was analyzed by TPH IR methods. The results revealed 18 ppm of PHCs.

Results of the February/March sampling round indicated the presence of trace concentrations of m,p-xylenes in sample GZB-1, as well as two unknown VOCs. A trace concentration of toluene, 39 ppb ethyl benzene, 275 ppb total xylenes and 40 unknown VOCs were detected in sample GZA-12.

Groundwater samples from wells GZB-1, GZB-5 and GZA-12 were screened for PHCs; none were reported above the 0.5 ppm detection limit. Samples from GZB-5 and GZA-12 were also screened for semi-VOCs; none were detected.

8.00 POTENTIAL MIGRATION PATHWAYS, EXPOSURE POINTS, AND RECEPTORS



As required under the MCP 310 CMR 40.00 (2)(b), GZA identified potential pathways of contaminant migration, exposure points, and human and environmental receptors of the contamination detected at the BRA Parcels A and B site in Boston Massachusetts. This discussion is based on information presented in this report and state and federal documents regarding environmentally sensitive receptors.

8.10 POTENTIAL MIGRATION PATHWAYS

Under current site conditions, the potential migration pathways for the detected contaminants include the leaching of soil contaminants (VOCs, PAHs, metals and PCBs) into groundwater and the migration of contaminated groundwater to Fort Point Channel approximately 2,000 feet downgradient of the site. Additionally, contaminated surficial soils may erode during the future construction planned for the property and wash into the storm sewer system, leading to eventual discharge into a downgradient surface water body.

The potential exists for the release of vapors and fugitive dust from contaminated soil and the volatilization of VOCs from the contaminated groundwater under the future construction scenario.

8.20 IDENTIFICATION OF EXPOSURE POINTS AND RECEPTORS

Environmentally sensitive areas as defined by the MCP include wetlands, areas subject to 100-year flooding and sensitive terrestrial and aquatic habitats. GZA has reviewed a number of state and Federal sources for information regarding the presence of such environmentally sensitive areas within the vicinity of the BRA Parcels A and B. These sources are listed below:

- U.S.G.S Topographic Map, Boston North Quadrangle (dated 1984);
- U.S. Fish and Wildlife Service, National Wetlands Inventory Map (NWI) (Boston North Quadrangle);
- Massachusetts Department of Environmental Protection, Division of Water Pollution Control (DWPC), Basin Classifications and Maps (310 CMR 4.06);
- U.S. EPA, Region I list of Priority Wetlands in New England (dated September, 1987);
- Massachusetts Natural Heritage Program (MNHP), Atlas of Estimate Habitats of State-listed Rare Wetlands Wildlife, 1992 Edition;

- July 1991 list of Areas of Critical Environmental Concern (from Department of Environmental Management, Division of Resource Conservation).

8.21 Potential Human Health Receptors

Given the current use of the property and the presence and potential for migration of contaminants described above, the likelihood of contact between potential human receptors (i.e. trespassers) and the contaminated soil and groundwater media is low due to the fact that the area is fenced.

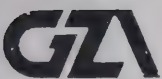
Construction on the site may expose construction workers to contamination through direct contact with surficial and subsurface soils and groundwater, and inhalation of fugitive dust.

Several factors may serve to mitigate the potential for exposures to human receptors. Construction activities are planned to begin in approximately six months and are likely to result in additional fencing around the parcel and increased security, which will minimize the potential for trespassing activities and subsequent exposure to site media. In addition, construction activities are governed by OSHA regulations and standards, which include specific provisions to limit direct contact to contaminated soils and groundwater.

8.22 Potential Environmental Receptors

The current setting of the site is urban/residential in nature. The site lies approximately 2,000 feet upgradient of the Fort Point Channel, which is part of Boston Inner Harbor. Fort Point Channel is considered part of the Boston Harbor Drainage System. While this area has Class SB status under the Massachusetts Surface Water Quality Standards (314 CMR 4.00) and can therefore technically be used for primary contact recreation, the water has poor aesthetic quality and is not likely to be used for this purpose. The channel is also, under these standards, designated as habitat for shellfish, other fish, and wildlife. However, past pollutant input due to urbanization of the area and the resultant poor water quality are likely to have greatly reduced the diversity of aquatic life.

Boston Inner Harbor and its nearby tributaries have been impacted by the urban nature of their surroundings. The Inner Harbor has been described by the Massachusetts Division of Marine Fisheries as anoxic in most portions for the greater part of the year. Fish which may be found in the oxygenated portions of the Harbor include winter Flounder (Pseudopleuronectes americanus), Alewife (Alosa pseudoharengus), Smelt (Osmeridae) and River Herring (Clupeidae). Commercial fishing is not allowed in the Inner Harbor and recreational fishing is generally not a recognized activity due to low fish abundance and diversity. However, some recreational fishing does occur in this area.



Potential direct exposure pathways for plants and wildlife most commonly associated with contaminated sites include some or all of the following: exposure to contaminated groundwater upon discharge to a surface water body, exposure to contaminated surface water and sediments, uptake of contaminated groundwater by plant roots, and exposure to contaminated soils. As with humans, exposure may take the form of direct contact, inhalation and ingestion. However, potential effects data associated with many plant and wildlife exposure scenarios are often limited. The exposure pathways considered for this site include off-site exposure to contaminated groundwater discharging to Fort Point Channel.

The levels of VOC detected in the site groundwater were compared to the U.S. Ambient Water Quality Criteria for the protection of marine life and found to be below these values. For this reason, it does not appear that the site contamination will have any adverse effects on the primary exposure point, Fort Point Channel.

It is also well known that, in general, VOCs must be present in relatively high concentrations in surface water to elicit toxic effects (in aquatic biota). It is likely that the concentrations of VOCs in site groundwater will be further diluted and attenuated (due to biodegradation, adsorption, and volatilization) before and after the groundwater discharges to surface water.

9.00 SUMMARY AND CONCLUSIONS

A Phase I - Limited Site Investigation was conducted at the BRA Parcels A and B on Washington Street in Boston, Massachusetts. The study included a site reconnaissance; a review of the site history; a review of available local, state and federal regulatory records; subsurface explorations, and chemical analyses of soil and groundwater samples. On the basis of the work conducted as part of this study, we have reached the conclusions described below:

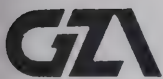
- The site is located near the Chinatown section of Boston, Massachusetts. Two schools, the Josiah Quincy School and the Don Bosco High School, are on the opposite side of Washington Street and within 500 feet of the site. The site is currently covered by an abandoned six-story building, paved and unpaved automobile parking areas, a playground, and the remnants of a vegetable garden. During our initial site reconnaissance, a few cans of spray paint, and automotive paint and an automobile garage bay were observed in the first floor of the site building. No evidence of the presence of hazardous material or oil were observed on the ground surface except for occasional isolated oil-like stains typically observed on automobile parking lots.
- Our historical review indicated that several small site buildings housed businesses such as a carpentry shop, a livery stable, a hotel, a stained glass

shop, a blacksmith shop, an armory, a furniture shop, a carpet shop, an appliance store, and an engraving shop. In addition, a substation, an elevated railway track, a playground, and a portion of a city street were also on the site.

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- Our review of municipal agency files did not indicate a release of hazardous material or oil at the site. The site was indicated to be serviced by municipal water and sewer services. No private or public supply wells were identified to within 1/4 mile of the site.
 - Review of DEP records did not indicate any reports of a release of hazardous material or oil at the site; however, several releases were indicated to have occurred within 1/4 mile of the site. Several businesses registered as RCRA hazardous waste generators were also indicated to be within 1/4 mile of the site. The DEP Water Supply Protection Atlas indicated that no public drinking water supply wells or reservoirs are within 1 mile of the site.
 - Subsurface conditions consist of between 6 and 13.5 feet of granular fill overlying natural silts and clays. Four deep borings encountered glacial till at depths ranging from 71 to 87 feet below ground surface and bedrock at depths of approximately 75 to 94.5 feet below ground surface. Groundwater was encountered at depths of approximately 6 feet to 13 feet below ground surface. Results of our groundwater elevation survey indicate that groundwater flows to the southeast toward the Massachusetts Turnpike and the Fort Point Channel.
 - Results of our chemical analyses of soil and groundwater samples generally indicated the presence of contaminants typically associated with urban sites. Chemical analyses of soil samples detected low levels of aromatic and petroleum-related VOCs, up to 5,400 ppm of PHCs, 1.1 to 82 ppm of PAHs, and 245 to 265 ppm of lead in soil samples from Parcels A and B. Chemical analyses results of groundwater samples detected low levels of aromatic VOCs and unknown compounds in five of 12 groundwater samples, a low level of PHCs in one of six groundwater samples, and levels below method quantification limits of two PAHs.

On the basis of the observations made and the information reviewed during the course of this Phase I - Limited Site Investigation as described above, it is GZA's opinion that the site is a "disposal site" as defined under the MCP. It is GZA's opinion that the site should be classified as a non-priority disposal site and that no Short-Term Measure is warranted due to the limited potential for exposure to site contaminants. Although two schools are located within 500 feet of observed contamination at the site, we do not believe the site poses an increased risk of exposure to children from the schools. In addition, it is also GZA's opinion that the site is eligible for a Waiver of Approvals for possible remediation of contaminated soils during the planned future development of the site.

While our testing results indicate the presence of hazardous materials in soils from the site, the limited analyses completed to date indicate that soils excavated during proposed construction would not be classified as hazardous wastes. Based on our recent discussions with DEP on similar projects, however, the fill material at the site will most likely be classified as a regulated soil requiring DEP approval for off-site disposal.



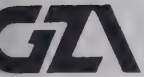
10.00 RECOMMENDATIONS

The presence of contaminated soils and groundwater at the site does not, in GZA's opinion, preclude development of the parcel. However, site planning and subsequent developments should proceed with caution to limit adverse environmental effects. Specifically, GZA recommends the following regarding site development.

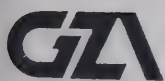
1. A full asbestos survey should be conducted in the existing building on Parcel B prior to demolition of the structure. The survey should be conducted by a qualified asbestos removal contractor.
2. Given the nature of past users of the site, there is a potential for aboveground and underground storage tanks to exist at the site. Localized zones of soil contamination may also exist in areas where borings were not completed. Excavation during proposed site development should be closely monitored by a qualified geotechnical engineer with hazardous waste management experience.
3. The proposed development will leave the site covered with asphalt, landscaped areas and/or structure, thus limiting future human exposure to soils. During construction, however, there will be soil excavated for foundation construction and utility installation. The contractor should be informed of the environmental concerns at the site so that he can take appropriate health and safety precautions for his workers and occupants of surrounding sites including the nearby schools.
4. Soils excavated during construction should be disposed in accordance with relevant state and federal guidelines. Appropriate technical specifications should be developed by the geotechnical engineer with regard to this issue. As an alternative to stockpiling and testing during construction, the soil at the site could be characterized prior to construction. This, however, would involve additional exploration and chemical testing to better evaluate the extent and composition of potentially contaminated material. The required testing would have to satisfy both the DEP and facilities where the material will be disposed. Although this may involve more testing than the "test-as-we-go" approach, it will

reduce the amount of on-site stockpiling and time-consuming testing, which could impact on the construction schedule. Also, the DEP still recommends full-time monitoring during excavation operations to confirm that conditions are as expected based on the boring program.

5. Dewatering may be required for construction activities at the site, and special provisions should be made for handling the pumped water. These may include procurement of environmental permits and/or monitoring of effluent water quality. GZA, therefore, suggests that the permitting process begin as soon as possible because of the long lead times involved with obtaining the necessary permits.



1.00 INTRODUCTION



In accordance with our proposal dated February 10, 1992, GZA GeoEnvironmental, Inc. (GZA) has completed a characterization of public health and environmental risks associated with exposures to oil and hazardous materials (OHM) present in soils and groundwater on Boston Redevelopment Authority (BRA) Parcels A and B, under current and reasonably foreseeable future uses. The objective of the characterization was to evaluate the level of risk to human health and the environment and risk of harm to safety and public welfare at the site. This assessment is subject to the Limitations presented in Appendix A.

1.10 BACKGROUND

This risk characterization is based primarily on observations of BRA Parcels A and B and analytical data presented in GZA's Phase I report (GZA's April, 1992 File No. 12854). For the purposes of this assessment, the study area has been defined as BRA Parcels A and B, and potential receptors of groundwater originating from the property. Parcel A is divided into two parcels designated as Parcel R3A1 and Parcel R3A2. Parcel B is a single parcel designated as Parcel R3B.

The site is located on Washington Street in a mixed residential and commercial section of Boston, Massachusetts. Refer to the Locus Plan provided as Figure 1. Oak Street is north of the site, beyond which is a parking lot. Washington Street is west of the site beyond which are the Josiah Quincy School and the South Cove Community Health Center. Marginal Road is south of the site, beyond which is the Massachusetts Turnpike. A residential area is immediately east of the site. The Fort Point Channel is approximately 2,000 feet southeast of the BRA site. Results of our groundwater elevation survey conducted in March 1992 indicate that groundwater is flowing to the southeast.

Parcel R3A1 currently consists of a gravel parking lot, and Parcel R3A2 is a paved parking lot. Parcel R3B is currently occupied by a vacant building, playground, basketball court, community garden, grassy area, and a gravel parking lot. Chain link fences surround the parcels and access is provided through several gates.

1.20 METHODOLOGY

In performing this risk characterization, Massachusetts Department of Environmental Protection (DEP) risk characterization guidance for MCP Phase II sites (DEP, May 1989) was used. This guidance outlines specific methodology for characterizing potential risks to public health and provides general guidance for environmental, safety and public welfare risk characterization. The following paragraphs in this section

discuss background information regarding BRA Parcels A and B, outline the methodology used in the risk assessment, and briefly summarize the results of the risk characterization. The public health risk characterization consists of four components:

Hazard Identification

The objectives of the hazard identification were to summarize the nature and extent of contaminants in soil and groundwater at and in the vicinity of the BRA site. The most recent soil and groundwater analytical data for the site were summarized. In addition, available surface water standards and guidelines are discussed in the hazard identification section.

Dose-Response Assessment

In the dose-response assessment component, the relationship between the potential dose of each compound received and the probability that an adverse health effect may occur was defined. Toxicity values, in the form of Reference Doses (RfDs) for threshold non-carcinogenic health effects and carcinogenic potency factors for non-threshold (carcinogenic) effects were compiled (U.S. EPA HEAST, January 1991). In addition, Allowable Threshold Concentrations (ATCs), which are toxicity values for evaluation of potential health effects associated with inhalation exposures, were obtained from Massachusetts DEP guidance documents (Massachusetts DEP, May 1990).

Exposure Assessment

In the exposure assessment, potential human and environmental receptors, exposure routes and exposure point concentrations were identified. The MCP and associated guidance describe four methods for site health risk characterization. The appropriate method was selected once potential receptors, exposure points, and exposure routes were identified, and it was known which compounds are likely to be present at these exposure points.

Risk Characterization

In the risk characterization component, exposure point concentrations of each compound were compared to applicable or suitably analogous standards and guidelines. Total site risks, calculated based on toxicity values and average daily doses, were compared to DEP risk limits.

1.30 SUMMARY

The Public Health and Environmental Risk Characterization for the BRA site has analyzed risks posed by the presence and migration of volatile organic compounds (VOCs), specifically toluene, ethylbenzene, and xylenes, and semi-VOCs including polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), associated with current and reasonably foreseeable future use of the site. These OHM were present in site soils; however, low levels of aromatic VOCs and PAHs were detected in site groundwater. A quantitative evaluation of both on-site public health (construction workers and trespassers) and off-site environmental (marine aquatic life) risks was the focus of the assessment.

Potential human health risks were evaluated for future construction worker direct contact with surficial and subsurface soils and groundwater, and inhalation of fugitive dust-generated during development of BRA Parcel R3B, which includes excavation for construction of building foundations. The total "screening level" subchronic noncarcinogenic hazard index (HI) and the cumulative segregated HI for the decreased body weight gain toxicity endpoint, as well as the incremental total cancer risk estimate for the future adult construction worker slightly exceeded DEP risk limits. It is noted that these risks can be reduced by adherence to appropriate health and safety protocols during construction.

We also evaluated potential risks under current conditions for child trespasser direct contact with surficial soils on BRA Parcels R3A1 and R3B. The cumulative segregated HI for the decreased body weight gain toxicity (e.g. lower than anticipated growth during development) endpoint and the total cancer risk estimate for the child trespasser exceeded DEP risk limits.

Evaluation of off-site risk due to migration of groundwater from the BRA site toward the Fort Point Channel indicated that mean site groundwater contaminant concentrations were below marine aquatic life criteria and would not pose a risk to these potential off-site receptors.

All of these risk estimates are based on a number of conservative exposure assumptions which tend to over estimate the exposures and resulting risks calculated in this evaluation. In addition, no contact with residual OHM will be possible based on proposed parcel development which includes paving and building on parcel areas and the addition of clean fill. Therefore, future exposures and development of the parcels will serve to reduce associated risks.

2.00 HAZARD IDENTIFICATION

The primary objectives of the hazard identification were to summarize the nature and distribution of OHM and to identify media and contaminants to be evaluated in the risk characterization. In addition, toxicity profiles for detected compounds were compiled, and applicable or suitably analogous public health and environmental standards and guidelines were identified or derived.



2.10 NATURE AND DISTRIBUTION OF CONTAMINANTS

Studies completed by GZA indicate that soil and limited groundwater contamination is present at the BRA site in the form of VOCs (toluene, ethyl benzene, and xylenes), semi-VOCs (PAHs and PCBs), and petroleum hydrocarbons (PHCs). These constituents are all common contaminants in urban soil and groundwater. Our experience indicates that these materials can be found in similar concentration ranges within most urban sites in the Boston area.

2.11 Soils

Soil samples collected from borings performed at the site and surficial soil samples collected from BRA Parcels A and B between February 24, 1992 and March 23, 1992, were screened for semi-VOCs (primarily PAHs). The highest total concentration of PAHs was detected in a composite soil sample (Composite 1) collected from boring GZA-13 (82 parts per million - ppm), located at the southeastern corner of Parcel R3A2 (see Figure 2). Total concentrations of PAHs up to 68 ppm were detected in soil samples collected from Parcel R3B, while total PAH concentrations up to 40 ppm were detected in soils on Parcel R3A1.

Analysis of a composite surficial soil sample collected from borings GZA-9, GZA-10, and GZA-12 on Parcel R3B indicated the presence of PCBs at 12 parts per billion (ppb), a concentration slightly above the method detection limit of 10 ppb. PCBs were not detected in soil samples collected from Parcels R3A1 and R3A2. Soil samples collected from the BRA Parcels were also analyzed for PHC content. Total PHC concentrations of 170 ppm were detected in soils collected from Parcel R3A1. Analysis of soil samples on Parcels R3A2 and R3B indicated total PHC concentrations up to 440 ppm and 830 ppm, respectively.

In summary, analysis of unsaturated zone soils from Parcels R3A1, R3A2, and R3B indicated elevated levels of PAHs and PHCs in surficial and subsurface soils. In addition, analysis of a composite surficial soil sample from Parcel R3B indicated the presence of PCBs at a concentration slightly above the detection limit.

2.12 Groundwater



Groundwater samples collected from monitoring wells on the BRA parcels between February 24, 1992 and March 9, 1992 were screened for VOCs by GC techniques. The most elevated total concentration of VOCs was detected in a groundwater sample collected from monitoring well GZA-12 (310 ppb), located on the northern portion of Parcel R3B. Trace levels of VOCs were detected in groundwater on the southwestern portion of Parcel R3B in one monitoring well, GZB-1. Low levels of VOCs were also detected in groundwater on Parcels R3A1 and R3A2 at total concentrations of 36 ppb and less than 15 ppb, respectively. In addition, several groundwater samples were screened for semi-VOCs. Analytical results indicated the presence of PAHs, specifically benzo(a) anthracene and chrysene, in groundwater on Parcel R2A1 at concentrations below the method quantitation limit of 5 ppb. Analysis of groundwater samples from the BRA parcels for PHC content did not detect PHCs at any location. In summary, low levels of VOCs were detected in groundwater in a limited number of monitoring wells on the BRA parcels.

3.00 DOSE-RESPONSE ASSESSMENT

As outlined in the DEP risk characterization guidance manual, the dose-response assessment describes the observed effects of exposure to a compound on humans, laboratory animals and/or aquatic organisms. This information is obtained from published literature describing epidemiologic or toxicologic studies involving a particular constituent. These dose-response values were integrated with information on the anticipated nature and magnitude of human and environmental exposure to characterize risks. In addition, applicable and suitably analogous standards and guidelines were identified.

3.10 REFERENCE DOSES AND CARCINOGENIC POTENCY FACTORS

The U.S. EPA has developed RfDs for the assessment of threshold (non-carcinogenic) effects of exposure and Carcinogenic Potency Factors (CPFs) for assessment of carcinogenic effects. These toxicity values were used to evaluate dose-response relationships in humans.

The chronic RfD represents a human intake level of a chemical, expressed in mg/kg/day (mg of contaminant per kg of receptor body weight per day), that is not likely to cause adverse effects when exposure is long-term. Subchronic RfDs are developed to assess shorter "subchronic" exposures, generally defined as representing exposures occurring over three months to less than 10 percent of a lifetime (seven years).

CPFs are used for the evaluation of potential effects of exposure to carcinogens. CPFs are derived by the U.S. EPA's Carcinogen Assessment Group as the upper 95 percent confidence limits of the slope of the dose-response curve. CPFs, expressed in $(\text{mg/kg/day})^{-1}$, are used to estimate probable incremental carcinogenic risk per unit of exposure over a lifetime. This incremental cancer risk estimate reflects the probability of excess cancers above the "background" cancer rate due to exposures to site contaminants.

The U.S. EPA has published RfDs and CPFs for exposures through the ingestion and inhalation routes. No values have been established for direct contact exposures; however, it is standard risk assessment practice to use values derived for ingestion to evaluate direct contact exposures. Toxicity values for the evaluation of direct contact soil were obtained from the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS), or from the U.S. EPA Health Effects Assessment Summary Tables when not listed in IRIS (U.S. EPA, February 1992; U.S. EPA, January 1991). The target organ or health effect associated with exposure and U.S. EPA's weight of evidence classification for potential carcinogenicity were also compiled. Dose-response information, for direct contact exposures to compounds detected in soils and groundwater at the BRA site, is presented in Table No. 1.

3.20 ALLOWABLE THRESHOLD CONCENTRATIONS AND ACCEPTABLE DAILY INTAKES

DEP has also developed ATCs for use in evaluation of threshold health effects from non-occupational inhalation exposures, when EPA Reference Doses are not available. ATCs were derived from the DEP's Threshold Effects Exposure Limits (TELEs) (DEP, May 1990). Acceptable Daily Intakes (ADIs) were calculated using ATCs and standard exposure assumptions for the potential receptors including inhalation rates and body weights. A summary of dose-response information for inhalation of fugitive dust exposure, including ADIs and CPFs for compounds detected in soil at the BRA site, is presented in Table No. 2.

3.30 IDENTIFICATION OF APPLICABLE OR SUITABLY ANALOGOUS PUBLIC HEALTH AND ENVIRONMENTAL STANDARDS AND GUIDELINES

Since current and foreseeable future use of the groundwater at and in the vicinity of the site is not for water supply, purposes, drinking water standards are not directly applicable to the site. In addition, state groundwater standards (314 CMR 6.0.6) which apply to permitted discharges to Class I and Class II groundwater are also not directly applicable to the study site.

To evaluate potential impacts to environmental receptors in the Fort Point Channel, U.S. EPA's Ambient Water Quality Criteria (AWQC) for the protection of marine

aquatic life were identified (U.S. EPA, 1986). Massachusetts Surface Water Quality Standards recommend AWQC as applicable limits for evaluating water quality (DEP, July 1990a). Therefore, these criteria have been used for comparison to concentrations of contaminants detected at the site and potentially migrating to the Fort Point Channel.

4.00 EXPOSURE ASSESSMENT

An exposure assessment was conducted based on data and analyses gathered during studies at the site to identify potential human and ecological receptors, and potential exposure points and pathways for each receptor. Based on this information, the appropriate risk characterization method was selected. For the exposure pathways outlined, current and relevant foreseeable exposure point concentrations were identified or modeled.

To evaluate potential exposure pathways we considered both current uses of the BRA site and the proposed development of the BRA parcels. As described in Section 1.10 of this report, Parcel R3A1 is currently a gravel parking lot, Parcel R3A2 is occupied by a paved parking lot and Parcel R3B consists of a vacant building, playground, basketball court, community garden, grassy area, and a gravel parking lot.

Based on our discussions with Chia Mingzse, architect for BRA Parcel A, future development of Parcel R3A1 will likely consist of a construction of a five-story, 19-unit residential complex. The building's foundation will consist of 3-foot-diameter caissons to the top of clay (about 10 to 15 feet below existing grade). The building footprint will cover the majority of Parcel R3A1. A small courtyard area will be constructed on the remaining portion of the parcel. The earliest planned activities on the parcel will begin between Fall 1992 and Spring 1993. Proposed development of Parcel R3A2 will consist of construction of a 115-unit residential complex with a landscaped courtyard area at the central and northern portion of the parcel. Development of Parcel R3A2 will not begin for approximately two to five years.

According to Mr. Steve Baker, site architect, future development of Parcel R3B includes demolition of the vacant six-story brick building and construction of several three and four-story buildings with residential units and one twelve-story residential complex, with a centrally located landscaped courtyard area. The northern portion of the parcel will be landscaped and contain brick walkways. The foundation for the twelve-story complex, to be situated on the western portion of the parcel, will consist of a mat foundation. Construction of the foundation will require excavation to the top of the clay strata, approximately 12 to 15 feet below ground surface. The proposed foundation for the three and four-story complexes will consist of 3-foot-diameter caissons to the top of clay. Building slabs will be at grade. Foundation work on

Parcel R3B is scheduled to begin in October 1992. The maximum duration of foundation construction is expected to be three months.

The two on-site human receptors included in our quantitative risk evaluation are adult construction workers, who may potentially be exposed to site contaminants in soil, groundwater, and fugitive dust during proposed development of the BRA site, and child trespassers who may be exposed to contaminants in surficial soils at the BRA site. Exposure to contaminants in soil and groundwater by the future construction worker could only be quantitatively evaluated for Parcel R3B since specific foundation design and construction information was provided for this parcel. It is likely that these exposures will be evaluated for the other parcels in the future, when plans for development are defined and specific design and construction information is available. Given that the site is located in a residential and commercial area, trespassers may access the parcels under current site conditions. There are complete exposure pathways for direct contact to surficial soils by a trespasser on Parcel R3A1 and Parcel R3B under current site conditions since Parcel R3A1 is a gravel parking lot and Parcel R3B contains grassy areas and a playground. However, there is not a complete exposure pathway for direct contact to surficial soils on Parcel R3A2, as the parcel is occupied by a paved parking lot. Following completion of proposed development of the parcels, there will be a lower potential for trespasser contact and exposure. Refer to Table 3, Exposure Assessment Summary, for a summary of the exposure profiles.

4.10 DIRECT CONTACT TO SOIL

4.11 Adult Construction Worker

There is no current exposure to construction workers at the site since the properties are undeveloped. Assuming that Parcel R3B is developed and the proposed residential complex is constructed, construction workers are likely receptors who may be exposed to contaminants in surficial and subsurface soils during future parcel development or foundation construction activities. Exposure to contaminants by construction workers may occur via dermal contact and incidental ingestion of surficial and subsurface (unsaturated zone) soils when areas of contamination within the proposed building footprint are made accessible during excavation activities for foundation construction. The proposed residential complex for Parcel R3B will require excavation to approximately 12 to 14 feet below ground surface for construction of the mat foundation for the twelve-story complex at the western portion of the parcel. The remaining three and four-story buildings on the parcel will not require excavation for construction of the foundation.

Analytical data included in the calculation of exposure point concentrations for direct contact and incidental ingestion of surficial and subsurface soils were selected based on proposed development of Parcel R3B. Exposure point concentrations for direct contact and incidental ingestion of soil by construction workers include only

compounds detected in unsaturated zone soils on Parcel R3B. Refer to Table 4 for a summary of analytical results for soil samples included and assumptions made regarding exposure point concentrations.

4.12 Child Trespasser

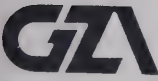
As indicated in Section 1.10 of this report, the BRA site is in a mixed commercial and residential area. Although the parcels are fenced, they are accessible to the public through several gates. Currently, the most likely exposures to children who trespass on BRA site would be from direct contact and incidental ingestion. Parcel R3A1 is currently occupied by a gravel parking lot, and Parcel R3B contains grassy areas and a playground. Exposures to contaminants in surficial soils by child trespassers would be limited to these two parcels since Parcel R3A2 is a paved parking lot and therefore, does not provide a complete exposure pathway. Average measured concentrations of contaminants in surficial soils (0 to 2 feet below grade) on Parcels R3A1 and R3B served as exposure point concentrations for direct contact and incidental ingestion exposure by child trespassers. Refer to Table 4 for a summary of analytical results and soil samples included. We conservatively (i.e. protective of public health) used the arithmetic mean concentration of OHM detected in soils to represent exposure point concentrations.

4.20 DIRECT CONTACT TO GROUNDWATER

Currently, contact with groundwater is not occurring. Assuming that Parcel R3B is developed and the proposed residential complex is constructed, construction workers are likely receptors who may be exposed to contaminants in groundwater during future parcel development and foundation construction activities. Exposure to contaminants by construction workers may occur via dermal absorption of groundwater when areas of groundwater contamination within the proposed building footprint are made accessible during excavation activities for foundation construction. The proposed building on Parcel R3B will require excavation to a depth of approximately 12 to 14 feet below ground surface for construction of the (mat) foundation for the twelve-story complex at the western portion of the parcel. Groundwater is approximately 8 feet below ground surface in this area of the parcel; therefore, excavation activities will likely encounter groundwater. The remainder of the proposed site development will not require excavation below observed groundwater leads. However, drilling operations related to caisson installation may provide a potential exposure pathway for contact with groundwater by the construction worker. Analytical data included in the calculation of exposure point concentrations for dermal absorption of groundwater by the future construction worker were selected based on proposed development of Parcel R3B. Exposure point concentrations for dermal absorption of groundwater by construction workers include only compounds detected in groundwater on Parcel R3B. Refer to Table 5 for a summary of analytical results, information regarding which groundwater samples were included. We conservatively used the arithmetic mean

concentrations of OHM detected in groundwater to represent exposure point concentrations.

4.30 INHALATION OF FUGITIVE DUST



Currently, exposure to fugitive dusts from the site are unlikely to be occurring. Assuming that Parcel R3B is developed and the proposed residential complex is constructed, construction workers are likely receptors who may be exposed to contaminants in fugitive dust generated during future parcel development or foundation construction activities. Exposure to contaminants detected in soil on Parcel R3B by construction workers may occur via inhalation of fugitive dust when areas of contamination within the proposed building footprint are made accessible and disturbed during excavation activities for foundation construction. The proposed building on Parcel R3B will require excavation to a depth of approximately 12 to 14 feet below ground surface for construction of the mat foundation for the twelve-story complex at the western portion of the property. The remaining buildings on the parcel will not require excavation for construction of the foundation. Average measured concentrations of contaminants detected in soils on Parcel R3B were used to represent the concentrations in soil which may contribute to future inhalation exposures (Table 4). The fugitive dust emission rate was estimated based on parameters including silt content, moisture content, and the number of bulldozers operating on the parcel. A "Near Field Box" model was used to estimate air concentrations based on emission rates, dimensions of the area of excavation, and average wind speed at the site. The estimated maximum (exposure point) concentrations of compounds in fugitive dust generated on Parcel R3B which may be inhaled by future construction workers are presented in Table 6. A more detailed description of the models and assumptions used to estimate exposure point concentrations are contained in Appendix C. It is anticipated that the worker will have the most intense exposure to fugitive dust during construction activities on Parcel R3B, relative to child trespassers and nearby residents; thus, potential inhalation exposures to residents and trespassers were not quantitatively elevated.

4.40 ESTIMATION OF AVERAGE DAILY DOSES AND EXPOSURE FACTORS

Average daily doses for each exposure pathway and total site risks for each receptor were calculated. Average daily doses (ADDs) for each compound were estimated for construction workers and child trespassers for each applicable exposure route. ADDs represent the amount of contaminant contacted and available for absorption into the body. ADDs were calculated as the amount of contaminant taken into the body per unit body weight per unit time (mg/kg/day) and are based on conservative exposure assumptions and factors developed in accordance with state and federal guidelines (DEP, May 1989; U.S. EPA; June 1989; U.S. EPA, July 1989). Subchronic and chronic ADDs were calculated for the evaluation of non-carcinogenic and carcinogenic

effects, respectively by multiplying exposure point concentrations and risk-specific exposure factors.

Exposure factors for subchronic non-carcinogenic and carcinogenic effects were calculated for each exposure pathway. Assumptions, equations, and calculated exposure factors for each exposure pathway are provided in Tables 7 through 10.

4.50 ENVIRONMENTAL RECEPTORS

Fort Point Channel, being the closest downgradient waterbody is likely to receive the groundwater flowing out of the BRA site. For this reason, Fort Point Channel may be considered the primary potential exposure point for site groundwater upon discharge to surface water.

Fort Point Channel is considered part of Boston Inner harbor within the Boston Harbor Drainage System. While this area has Class SB status under the Massachusetts Surface Water Quality Standards (314 CMR 4.00) and can therefore technically be used for primary contact recreation. However, the water has poor aesthetic quality (Massachusetts DEP Non-Point Source Assessment Report, 1989) and is not likely to be used for this purpose. The channel is designated as habitat for fish, and wildlife, although past pollutant input and poor water quality are likely to have greatly reduced diversity.

Since mean site groundwater concentrations of VOCs were low and do not exceed the U.S. EPA AWQC Marine, it is likely that contaminant concentrations and associated impacts to aquatic life resulting from the presence of OHM in groundwater will be negligible when they reach the Fort Point Channel approximately 2,000 feet downgradient.

5.00 RISK CHARACTERIZATION

The objective of this component of the public health and environmental risk characterization is to compare hypothetical exposure point concentrations to applicable standards and guidelines. The risk characterization focused on conservative (e.g. protective of human health) scenarios of current and future exposures under present conditions of chemical distribution. In addition, total site risks were calculated using toxicity values and ADDs described in previous sections. Non-carcinogenic and carcinogenic effects were assessed separately based on the methodologies presented below.

5.10 COMPARISON WITH STANDARDS AND GUIDELINES

As stated previously, it is not anticipated that BRA site groundwater will significantly impact marine aquatic life in the Fort Point Channel given that low concentrations of VOCs were detected in groundwater on the BRA parcels, and these concentrations do not exceed the U.S. EPA AWQC for the protection of marine life.

5.20 CALCULATION OF SITE RISKS

The paragraph below discuss the methodology used to calculate site risks and the risk characterization results for each exposure pathway.

5.21 Methodology

To evaluate non-carcinogenic risks, a HI was calculated. The HI yields a general indication of whether exposures are likely to result in adverse health effects. To evaluate the non-carcinogenic effects for each OHM, the estimated ADD was divided by the appropriate RfD to yield a HI:

$$\text{Hazard Index} = \text{ADD}/\text{RfD}$$

For multiple chemical exposures, single HIs were summed to yield the cumulative HI for an individual exposure pathway. A total HI was derived by summing the cumulative HIs for each exposure pathway. This calculated total HI was compared to the total non-cancer limit of 0.2 specified in the MCP.

This approach assumes an additivity of toxic effects by the same mechanism and similar effects on target organs. Consequently, the application of this approach to a mixture of compounds that are not expected to induce the same type of effects could over estimate the probable risk. Therefore, the total "screening" HI, if it exceeded 0.2, was segregated by toxicity endpoint and these segregated indices compared to the DEP limit of 0.2.

Carcinogenic risks from exposure were evaluated as probabilities. To assess incremental lifetime cancer risks from exposures to individual chemicals, the lifetime ADDs were multiplied by their respective CPFs to yield a chemical-specific lifetime cancer risk estimate:

$$\text{Risk} = \text{ADD} \times \text{CPF}$$

For multiple chemical exposures, chemical-specific risk estimates for specific exposure pathways were summed to yield a cumulative risk estimate. A total risk estimate for each receptor was derived by summing the pathway-specific risk estimates. This summation assumes that individual intakes are small. It also assumes

independence of action by the compound involved (i.e., that there are no synergistic or antagonistic interactions and that all chemicals have the same toxicological mechanism and endpoint).

This calculated total risk estimate was compared to the total risk limit of 1×10^{-5} specified in the MCP. This level represents a probability of one incremental cancer case per 100,000 people exposed.



5.22 Direct Contact to Soils

Adult Construction Worker

Potential future risks associated with direct contact exposure to surficial and subsurface soils by adult construction workers (exclusively) during site development activities involving excavation for construction of building foundations, are presented in Table 11. The cumulative subchronic hazard index as was 2.9×10^{-1} , with 2.9×10^{-2} for the liver toxicity endpoint and 2.1×10^{-1} for the decreased body weight gain (i.e. lower than anticipated growth during development) toxicity endpoint. The cumulative screening level subchronic hazard index slightly exceeds the applicable criterion of 0.2, as does the segregated hazard index for the decreased body weight gain toxicity endpoint. The segregated HI for liver effects does not exceed the MCP non-carcinogenic risk criteria. The incremental cancer risk estimate for potential carcinogenic effects was 9.1×10^{-4} , slightly above the MCP risk criteria.

Child Trespasser

Potential current risks associated with direct contact to surficial soils by child trespassers on BRA Parcels R3A1 and R3B are presented in Table 12. The cumulative screening level subchronic hazard index for Parcel R3A1 is 8.1×10^{-1} , with 8.0×10^{-2} for the liver toxicity endpoint, and 1.2×10^{-1} for the decreased body weight gain toxicity endpoint. The cumulative screening level subchronic HI slightly exceeds the applicable criteria of 0.2 as does the segregated HI for the decreased body weight gain toxicity endpoint. The segregated HI for liver effects does not exceed the MCP risk criterion. The incremental cancer risk estimate for potential carcinogenic effects for Parcel R3A1 was 2.8×10^{-3} , above the MCP risk criteria. The cumulative subchronic hazard index for Parcel R3B is 2.9×10^{-1} , with 2.9×10^{-2} for the liver toxicity endpoint, and 2.1×10^{-1} for the decreased body weight gain toxicity endpoint. The cumulative screening level subchronic HI slightly exceeds the applicable criterion of 0.2 as does the segregated HI for the decreased body weight gain toxicity endpoint. The segregated HI for liver effects does not exceed the MCP risk criterion. The incremental cancer risk estimate for potential carcinogenic effects for Parcel R3B was 1.1×10^{-3} , above the MCP risk criteria.

5.23 Direct Contact to Groundwater

Adult Construction Worker



Potential future risks associated with direct contact exposure to groundwater by adult construction workers during site development activities involving excavation for construction of building foundations are presented in Table 13. The cumulative subchronic HI was 3.3×10^{-3} , with 1.4×10^{-3} for the liver toxicity endpoint. Since no carcinogenic potency factors were available for the detected compounds, a cancer risk estimate for potential carcinogenic effects could not be calculated. The HIs for direct contact to groundwater do not exceed the MCP risk criteria.

5.24 Inhalation of Fugitive Dust

Adult Construction Worker

Potential future risks associated with inhalation of fugitive dust by construction workers during future site development activities, which involve excavation for construction of building foundations, are presented in Table 14. The cumulative subchronic HI was 1.6×10^{-4} , with 1.7×10^{-5} for the liver toxicity endpoint and 1.2×10^{-4} for the decreased body weight gain toxicity endpoint. The cancer risk estimate for potential carcinogenic effects was 3.0×10^{-7} . Neither the HIs nor the incremental cancer risk estimate exceed the MCP risk criteria.

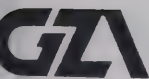
5.25 Total Site Risks

Table 15 provides a summary of risk estimates for the adult construction worker and the child trespasser. It was conservatively assumed that the same adult construction worker receptor would be exposed to soil, groundwater, and fugitive dust during proposed development of Parcel R3B involving excavation for building foundations. It was also conservatively assumed that trespassers would be exposed to surficial soils under current conditions and through completion of development on Parcels R3A1 and R3B. Total HIs and site cancer risks were calculated by summing each of the pathway-specific cumulative HIs and risk estimates for each of these pathways.

The total subchronic non-carcinogenic HI for future adult construction workers was 2.9×10^{-1} , of which the direct contact to soils pathway contributed most significantly. The cumulative segregated HIs for the liver toxicity endpoint and the decreased body weight gain toxicity endpoint were 2.9×10^{-2} and 2.1×10^{-1} respectively, of which the direct contact to soils pathway contributed most significantly. The total cancer risk estimate for potential carcinogenic effects was 9.1×10^{-4} . Therefore, the total subchronic noncarcinogenic HI and the cumulative segregated HI for the

decreased body weight gain toxicity endpoint, as well as the total cancer risk estimate, for the adult construction worker slightly exceed DEP risk limits.

The cumulative segregated non-carcinogenic HI for direct contact to surficial soils by child trespassers on Parcels R3A1 and R3B was 8.3×10^{-1} for the decreased body weight gain toxicity endpoint, and 1.1×10^{-1} for the liver toxicity endpoint. The total cancer risk estimate for potential carcinogenic effects was 3.9×10^{-3} . Therefore, the cumulative segregated HI for decreased body weight gain and the total cancer risk estimate for the child trespasser exceed DEP risk limits.



6.00 SAFETY AND PUBLIC WELFARE CHARACTERIZATION

Although the MCP requires a characterization of risk of harm to safety and public welfare, DEP has issued only limited policy and guidance for this component of the risk characterization. Current and reasonably foreseeable future site conditions do not pose fire or explosion hazards. No nuisance odors associated with the BRA site were identified. The only safety and welfare issues that appear to be relevant to the BRA site are health and safety concerns for workers during proposed development activities on Parcel R3B and child trespassers who may access BRA parcels when surficial soil contamination is present. However, construction activities are governed by OSHA regulations and standards, which prohibit direct contact to contaminated soil and groundwater. In addition, construction activities on Parcel R3B are planned to begin in approximately six months and will likely result in additional fencing around the parcel and increased security and subsequently, minimize trespassing activities in this area of the BRA site.

7.00 UNCERTAINTIES ANALYSIS

The findings of the risk characterization are dependant on a number of factors including the representativeness and quality of data describing site conditions and the nature and extent of contamination, as well as data and assumptions incorporated into the exposure and risk evaluations. Uncertainties in the measurements and assumptions will combine to provide uncertainty in the results of the risk characterization.

The conclusions presented in this report were based primarily on sampling performed during our Phase I investigation of the BRA site. Where sampling data did not give a complete characterization of soil and groundwater conditions, reasonable assumptions have been made.



Uncertainty also enters the risk analysis in the exposure scenarios. Our use of models for estimation of fugitive dust emissions incorporated conservative assumptions based on the nature of activities related to development of Parcel R3B. Selection of the bulldozer traffic model to estimate the emission rate of fugitive dust into the air required an assumption regarding the number of bulldozers that would be operating on Parcel R3B. Considering the size of Parcel R3B, our assumption for the number of bulldozers was mostly likely higher than the actual number of bulldozers that would be required for parcel development activities. Therefore, exposure point concentrations on Parcel R3B are likely to be lower than those estimated due to the conservative assumptions incorporated into our air modeling of fugitive dust emissions. It should also be noted that the duration and intensity of fugitive dust emission exposures represent conservative assumptions. Implementation of required and standard fugitive dust emission control techniques (e.g., spraying the affected area with water containing a surfactant) prior to and during excavation/construction activities will limit emissions on Parcel R3B, and thus the potential for exposure by future construction workers.

In our calculation of chemical exposure factors for the direct contact to soil exposure scenario, we also incorporated assumptions which are protective of human health. We assumed that the adult construction worker would be exposed to contaminants in soils on Parcel R3B for the entire duration of foundation construction and would be exposed six days per week during that time. The duration of the construction worker's exposure is most likely an overestimate. Similarly, we assumed that the child trespasser would be exposed to contaminants in surficial soils on Parcel R3A1 and Parcel R3B until completion of proposed development on these parcels. Surficial areas of contamination are likely to be removed during the initial development of these parcels, thus removing potential exposure points for trespassers. In addition, although the parcels are currently fenced with a limited number of entrances, it is likely that additional security measures will be implemented during site development activities, including locked gates and barriers, which will further limit access to the site.

In addition, the RfDs and CPFs used in the calculation of HIs and risk estimates are conservative values. Because the RfDs are derived using a number of safety factors and are developed to protect sensitive populations, the actual dose associated with a health effect is likely to be higher than the RfD established by the EPA for most groups in the general population. In addition, the CPFs are derived based on the upper 95 percent confidence limit.

Although the range of uncertainty was not quantified, the use of conservative assumptions and parameters throughout the assessment would be expected to err on the side of the protection of human health. Thus, the HIs and risk estimates calculated are likely to result in upper-bound estimates of the actual hazard resulting from exposure to compounds present at or near the site. Consequently, the results of the analysis should be used to highlight potential sources of risk associated with

exposures to substances present in soils at or near the site and to assist in providing a practical perspective of the options available for remediation at this site, rather than interpreted as absolute estimates on health risks.

8.00 FINDINGS AND EVALUATION OF NEED FOR REMEDIAL RESPONSE



The MCP indicates that remedial response at a site may be warranted if any exposure point concentrations exceed applicable public health or environmental standards, if any HI exceed 0.2, or if total cancer risk estimates exceed 10^{-5} (310 CMR 40.545 (3)(i)). The total HI and total cancer risk estimates for the child trespasser and future adult construction worker were compared to these MCP criteria.

The total subchronic non-carcinogenic HI (2.9×10^{-1}), the segregated HI for decreased body weight gain (2.1×10^{-1}), and the incremental cancer risk estimate (9.1×10^{-4}) for the future adult construction worker slightly exceeded applicable MCP criteria. The segregated HI for decreased body weight gain (1.1×10^{-1}) and the incremental cancer risk estimate (3.9×10^{-3}) for the child trespasser also exceeded applicable MCP criteria.

All of these risk estimates are based on a number of conservative exposure assumptions which tend to overestimate the exposures and resulting risks calculated in this evaluation. Notably we evaluated exposures to future construction workers assuming the absence of a health and safety plan which would most likely require personal protective equipment for site work. Our evaluation also reflects conservative estimates of the construction worker's exposure duration. In addition, modeling of fugitive dust emissions and air concentrations on BRA Parcel R3B are based on conservative parcel-specific assumptions which would subsequently result in an overestimate of the future construction worker exposure. In our evaluation of the child trespasser exposure, we assumed that the child would maintain access to the BRA parcels, currently fenced with a limited number of entrances, during site development activities when additional security (locked gates and barriers) will most likely be implemented.

Based on the results of this risk characterization, the potential impacts to public health and the environment will be greatly reduced as a result of development of the BRA parcels. Risks due to exposures to BRA site contaminants are likely to be diminished based on proposed development of the parcels which will result in excavation and removal of some of the PAH-contaminated soils, construction from attached buildings, pavement of courtyard areas, and addition of clean fill to proposed landscaped and grassy areas.

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U.S. Environmental Protection Agency (EPA), Office of Water, Quality Criteria for Water, Ambient Water Quality Criteria, Washington, D.C. 1986.

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U.S. Region I "Draft Final Supplemental Risk Assessment Guidance for the Superfund Program." Part I - Guidance for Public Health Risk Assessment, Boston, Massachusetts, EPA 901/5-89-001, June 1989.



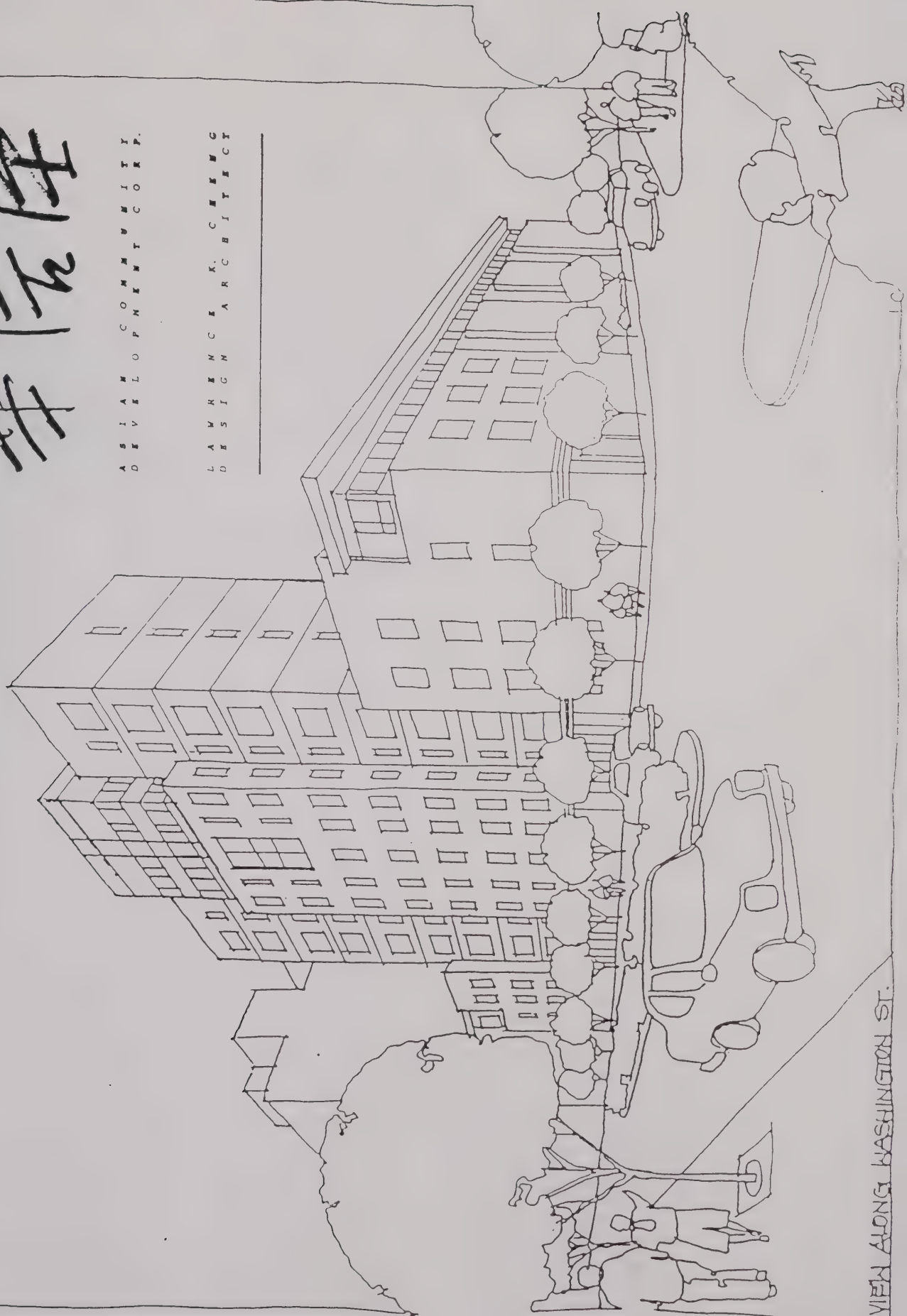
APPENDIX G: URBAN DESIGN COMPONENT

O A K T E R R A C K

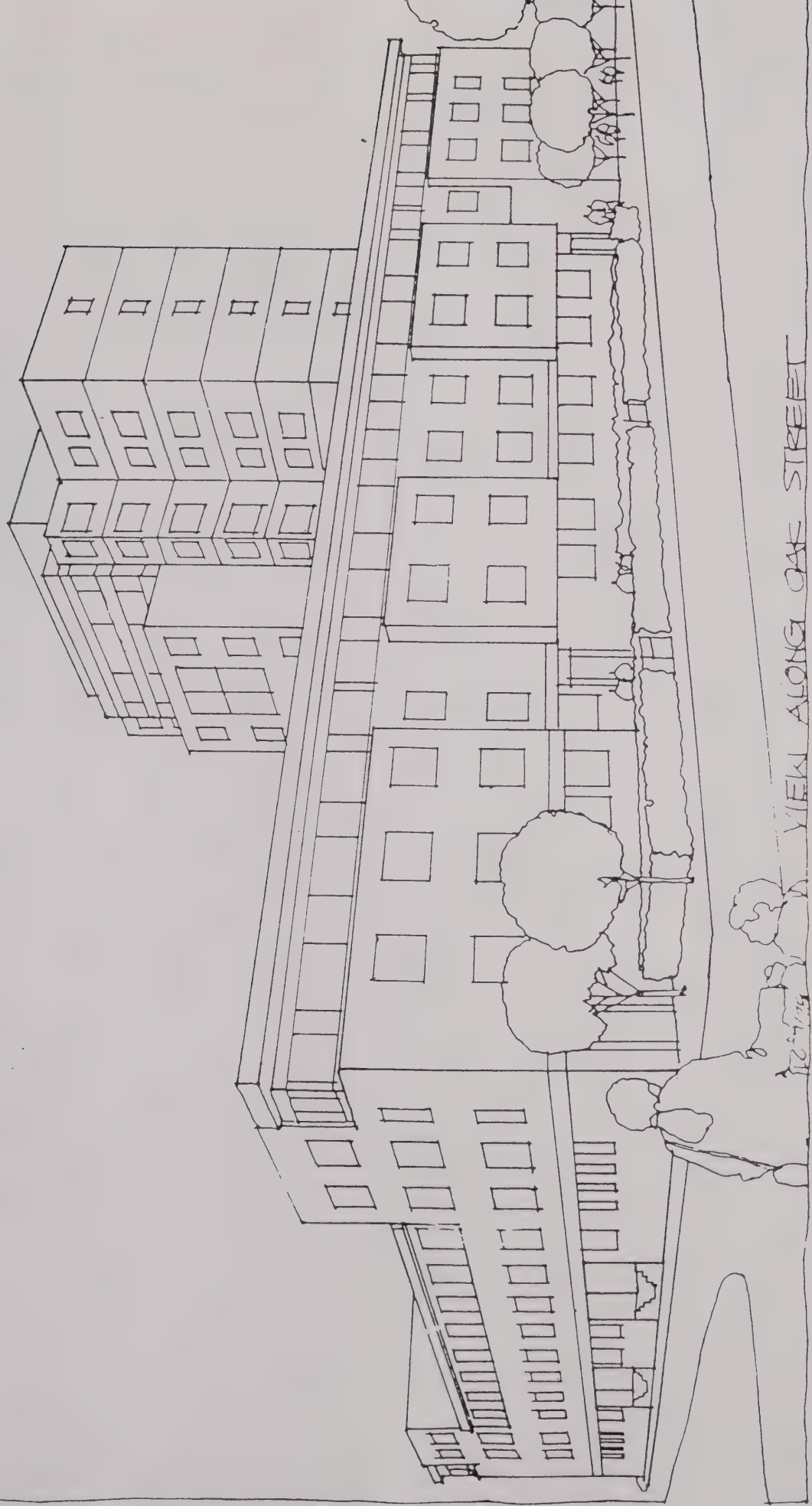
華信屋

A S I A M C O M M U N I T Y
D E V E L O P M E N T C O R P .

L A M H E N C E K . C H E N G
D E S I G N A R C H I T E C T

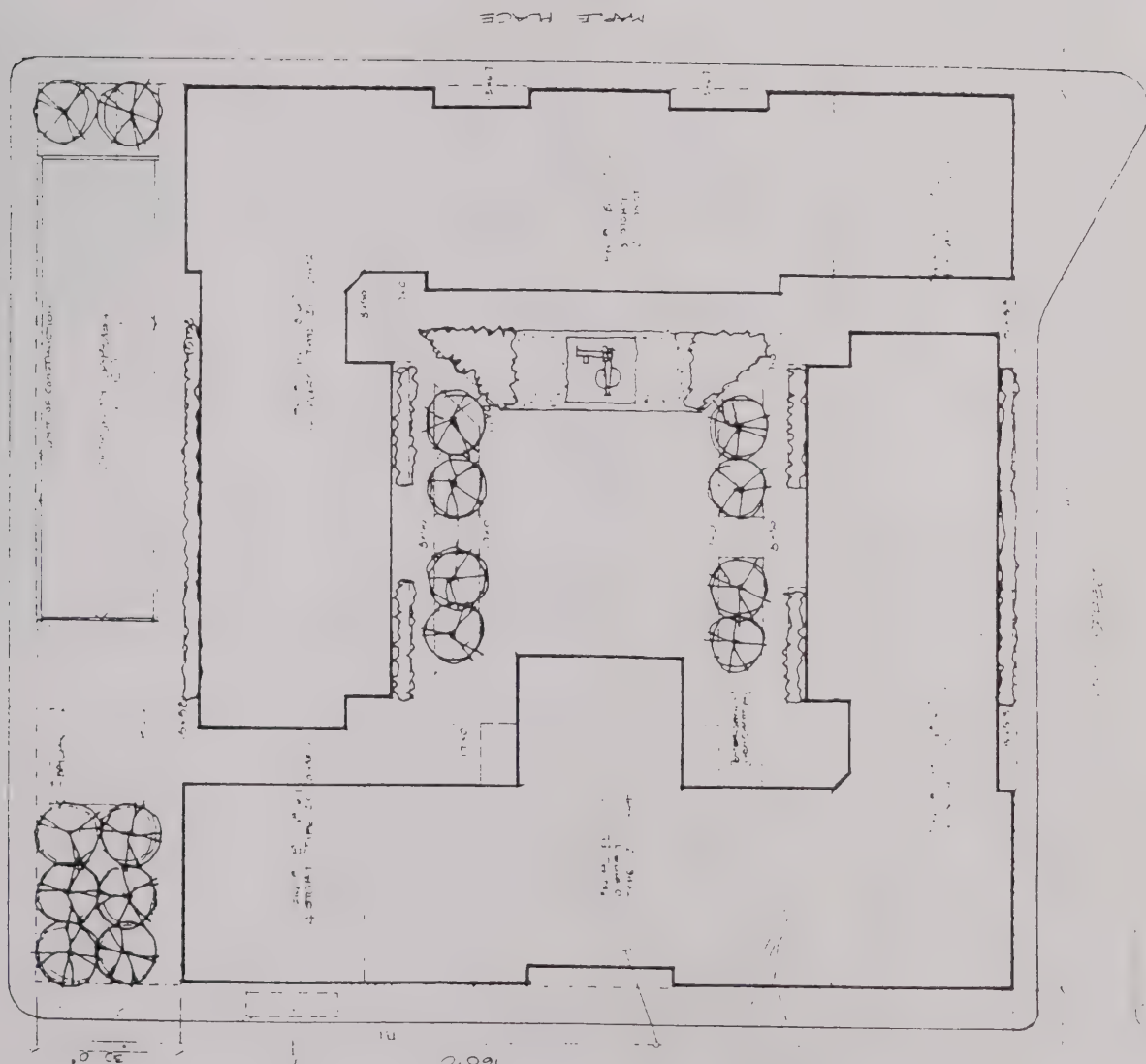


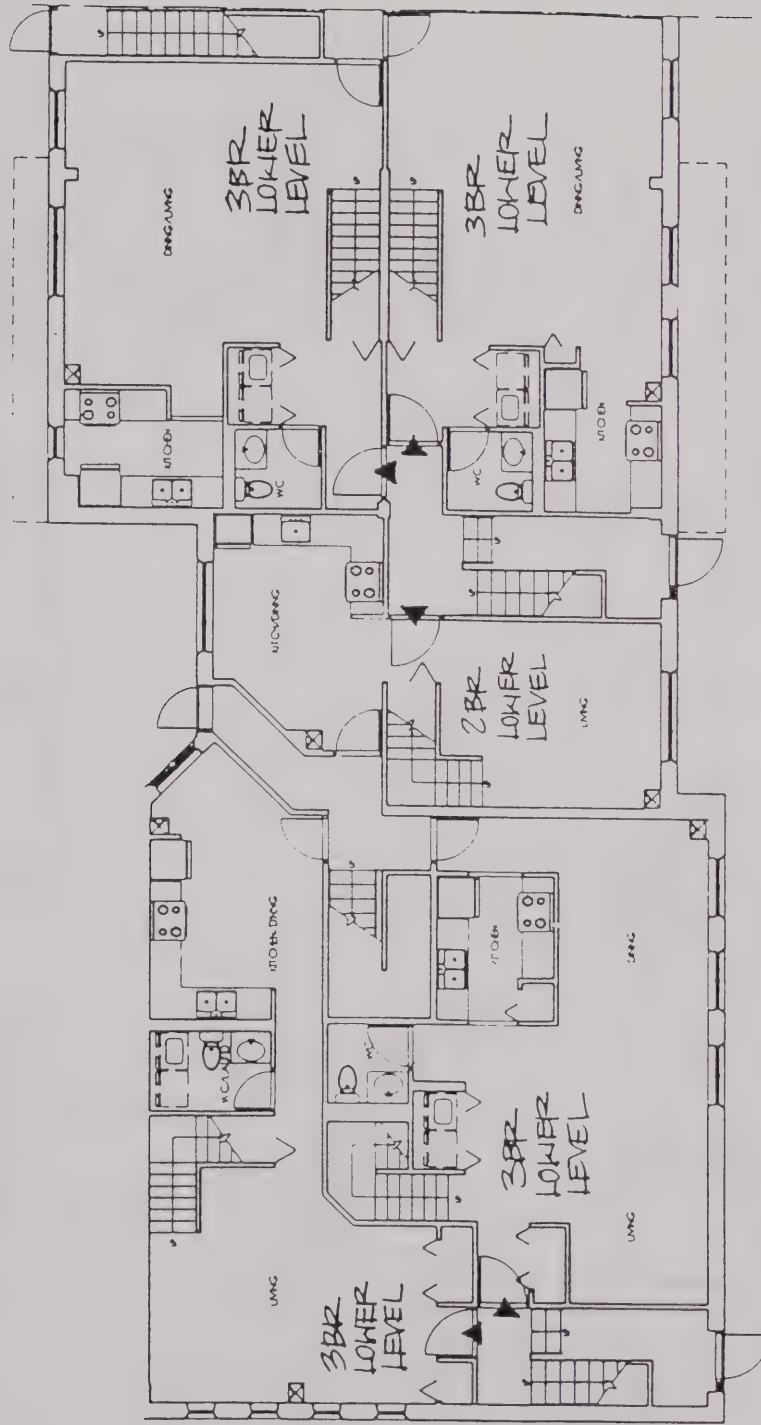
VIEW ALONG WASHINGTON ST.



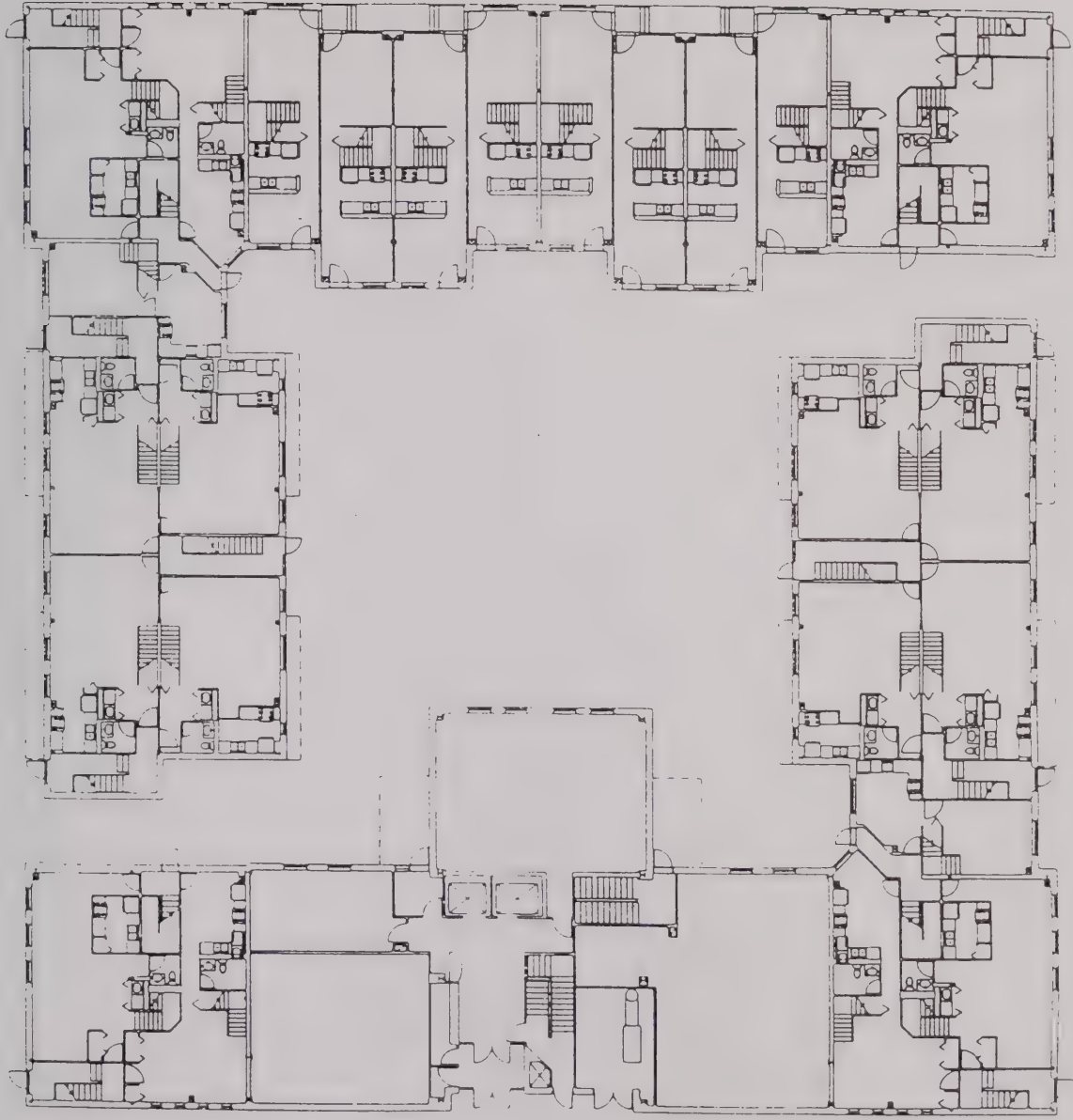
VIEW ALONG OAK STREET

STEPLAZ



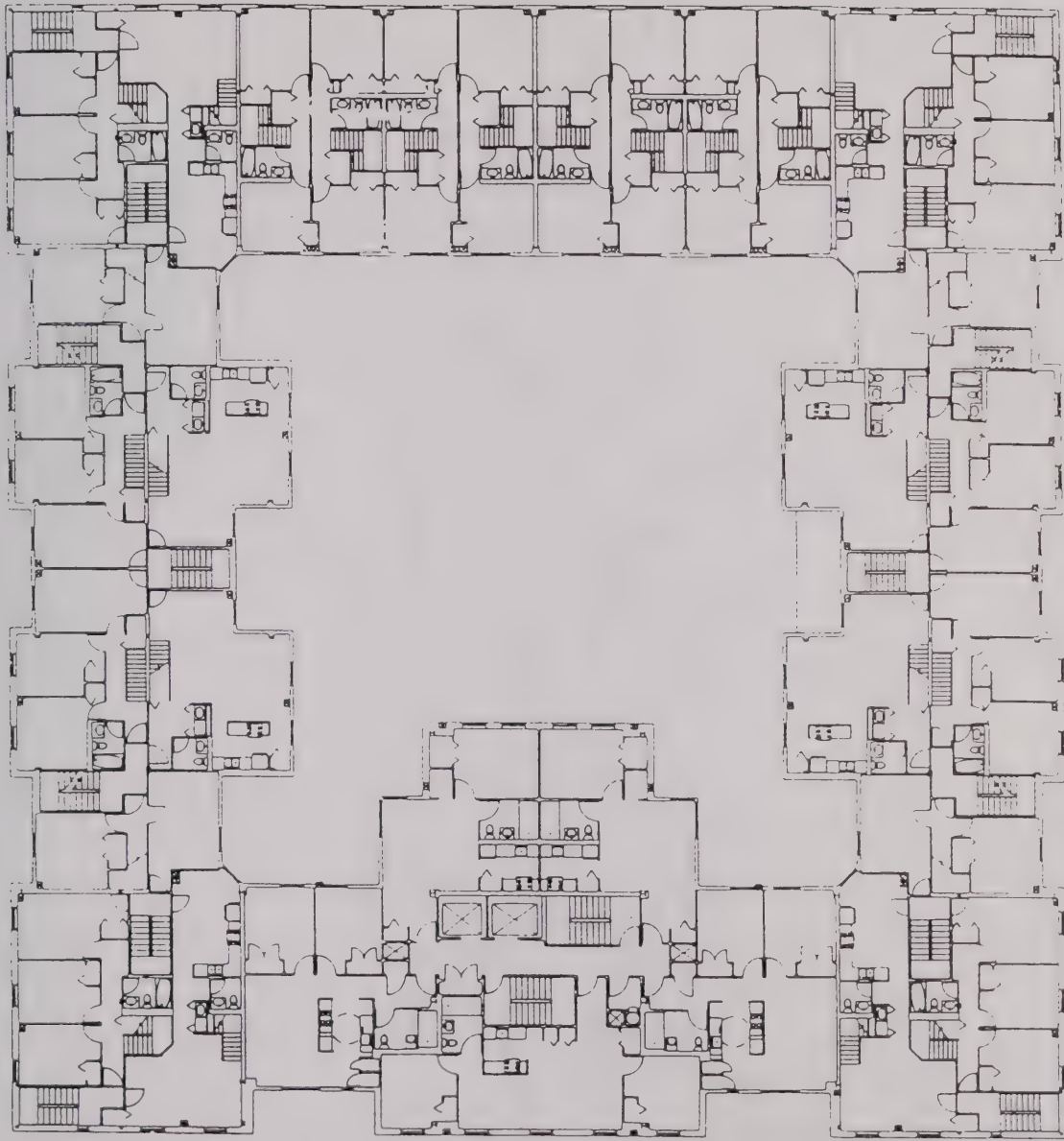


FIRST FLOOR
UNIT PLAN - LOW RISE



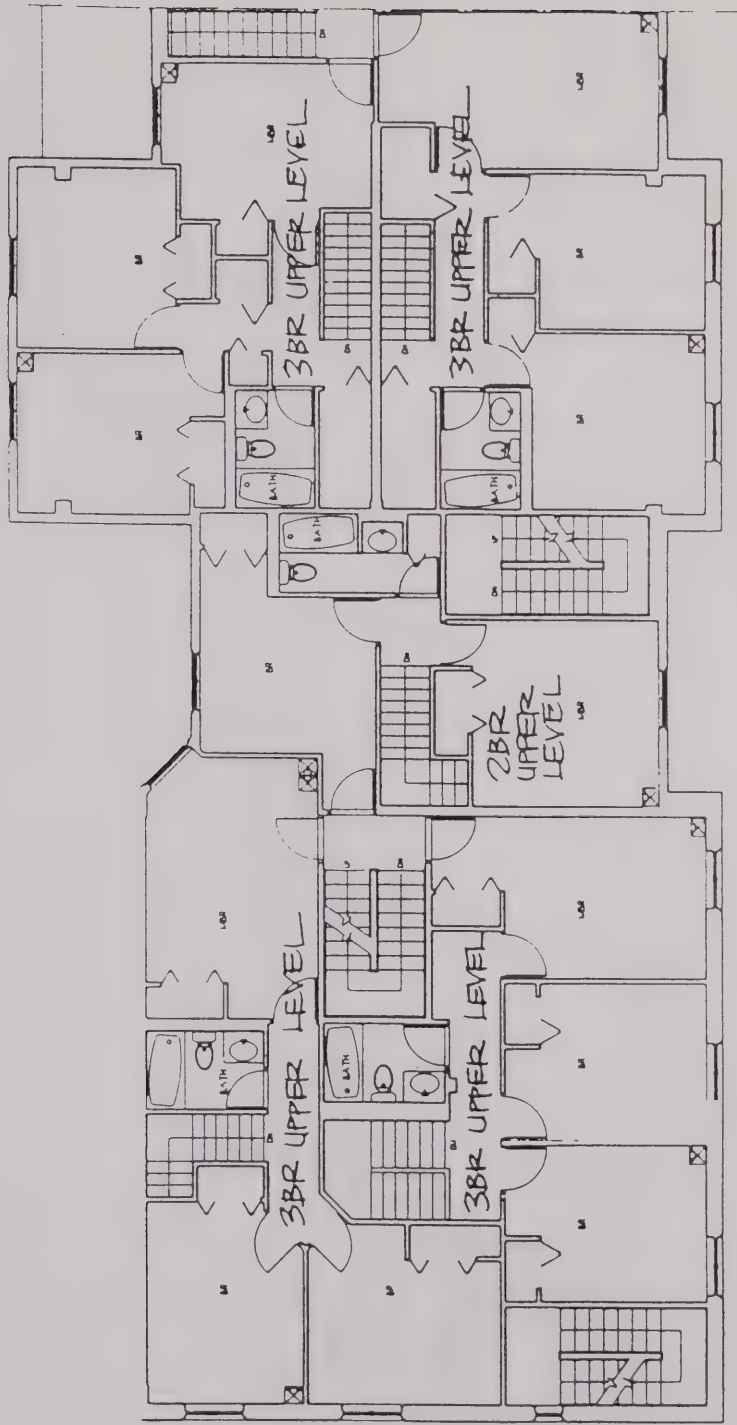
1.5 FLOOR BUILDING PLAN

FIRST FLOOR BUILDING PLAN

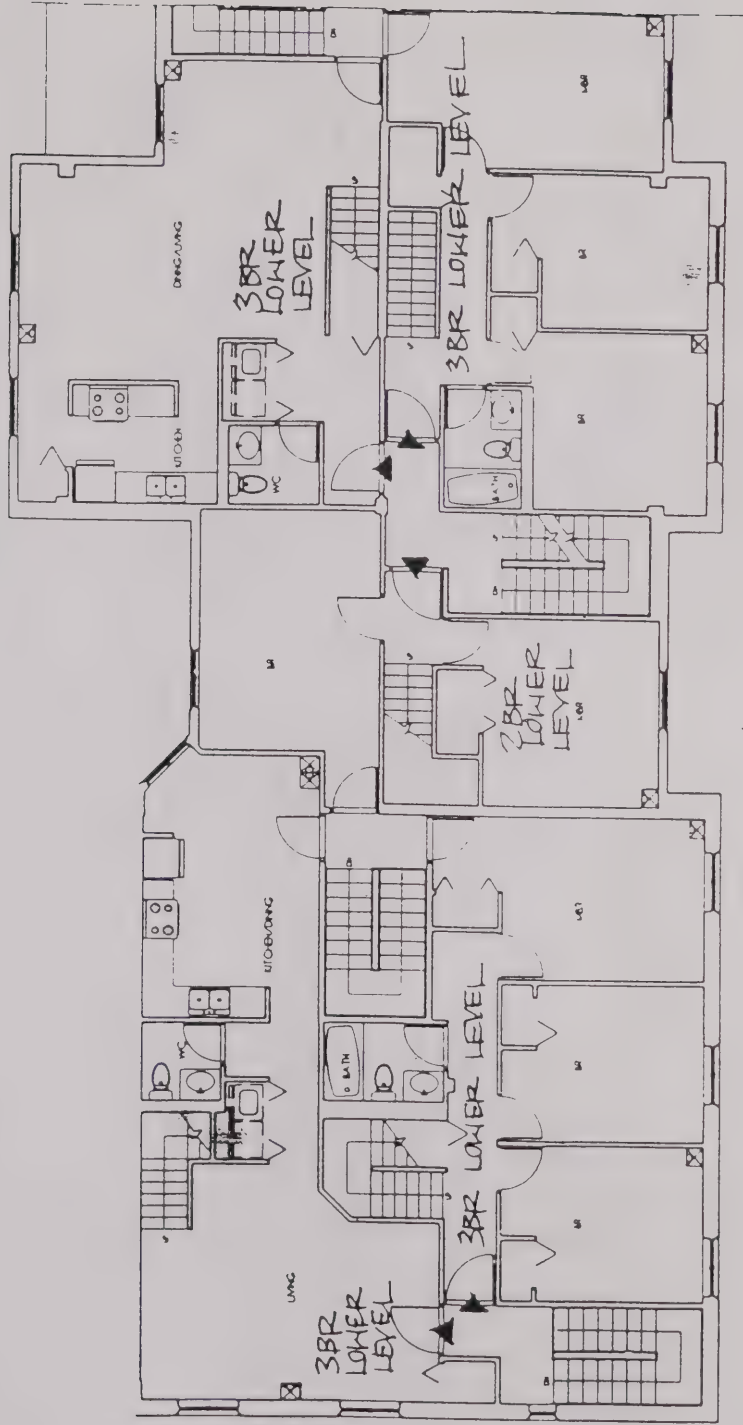


1188 THIRD FLOOR PLAN

THIRD FLOOR BUILDING PLAN



SECOND FLOOR—
UNIT PLAN • LOW RISE



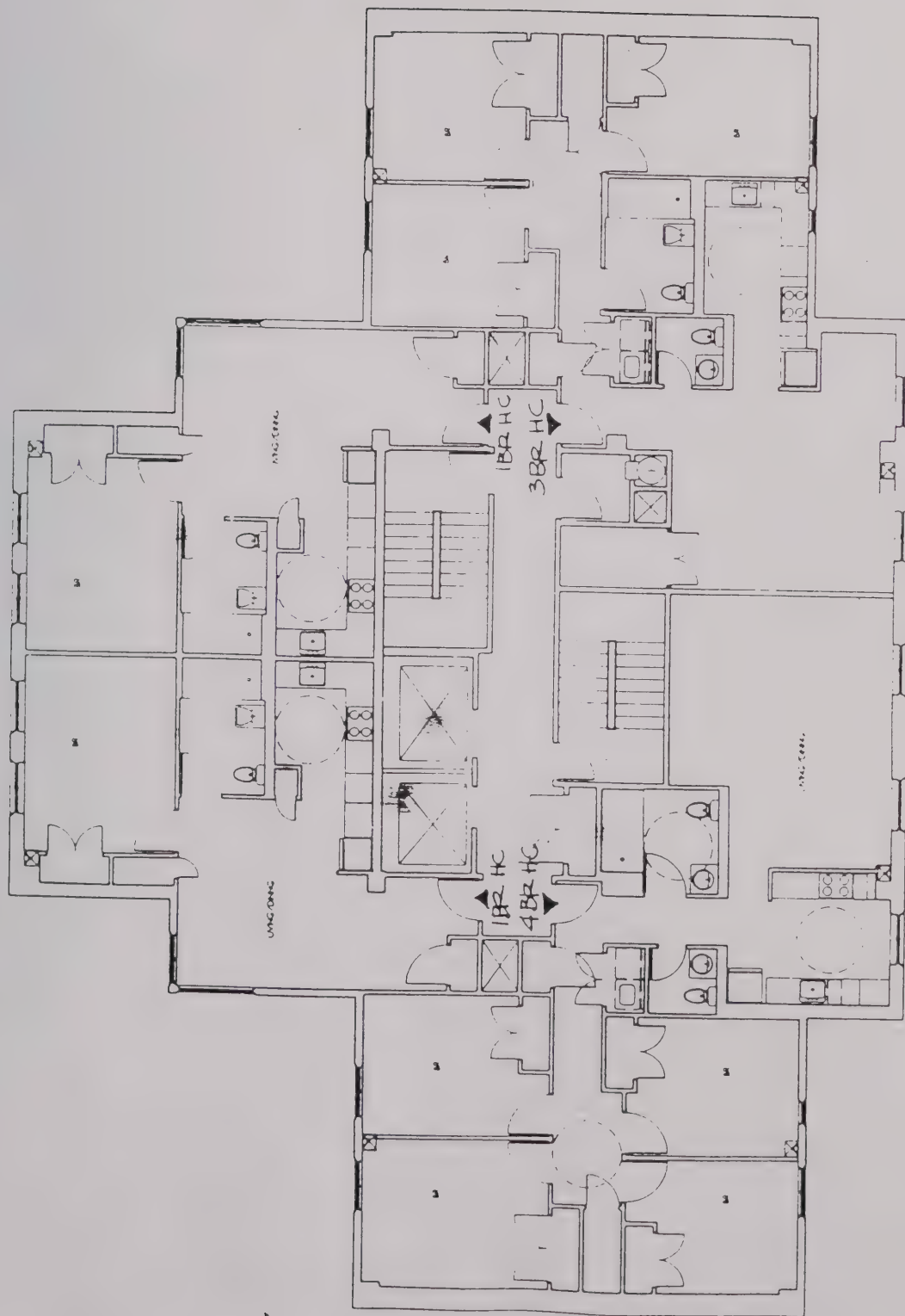
THIRD FLOOR
UNIT PLAN • LOW RISE



FOURTH FLOOR
UNIT PLAN • LOW RISE



LOWER FLOOR PLAN
TYPICAL FLOOR

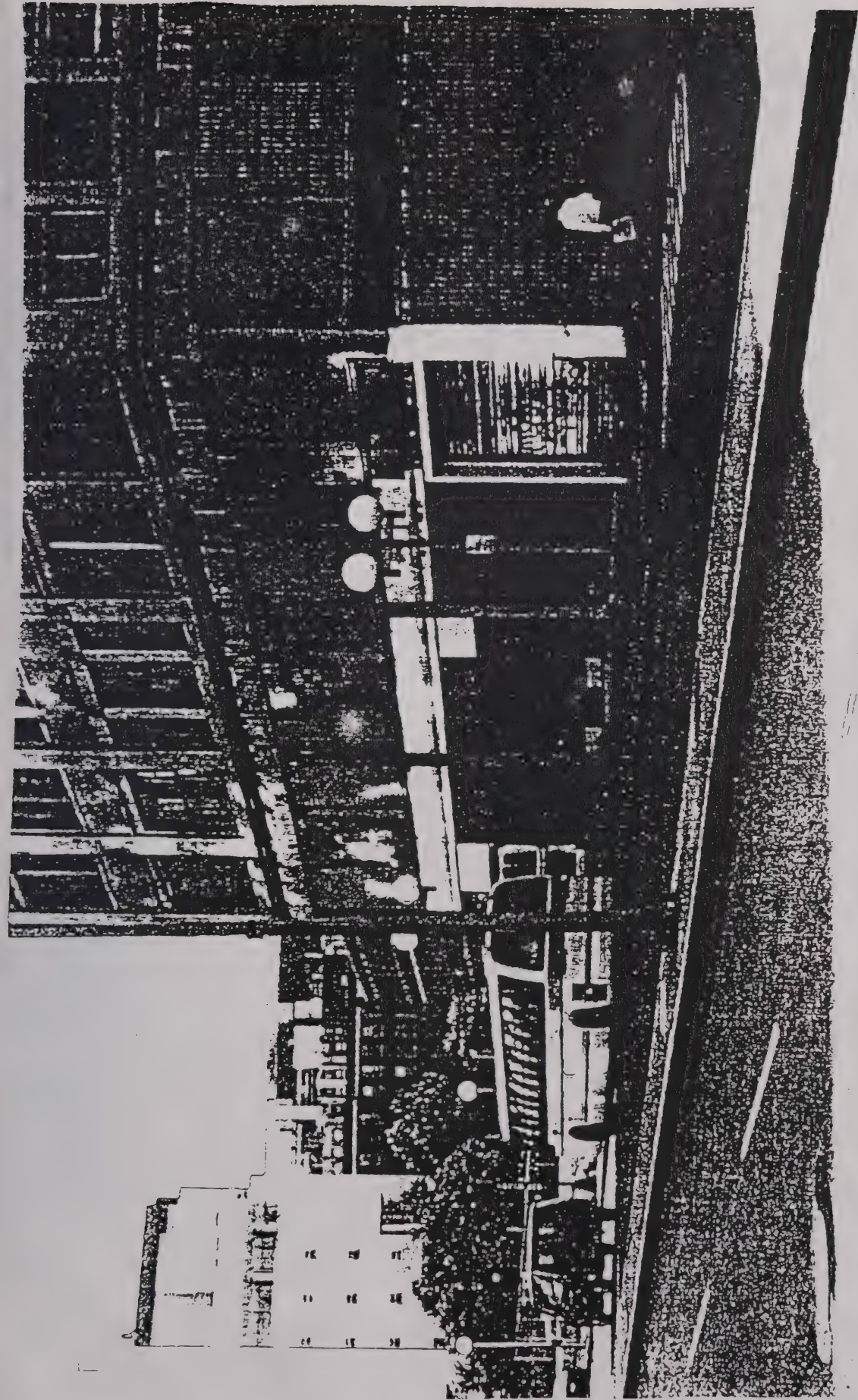


LOWER 2ND FLOOR
24 HC UNITS

APPENDIX H: PHOTOS OF SITE

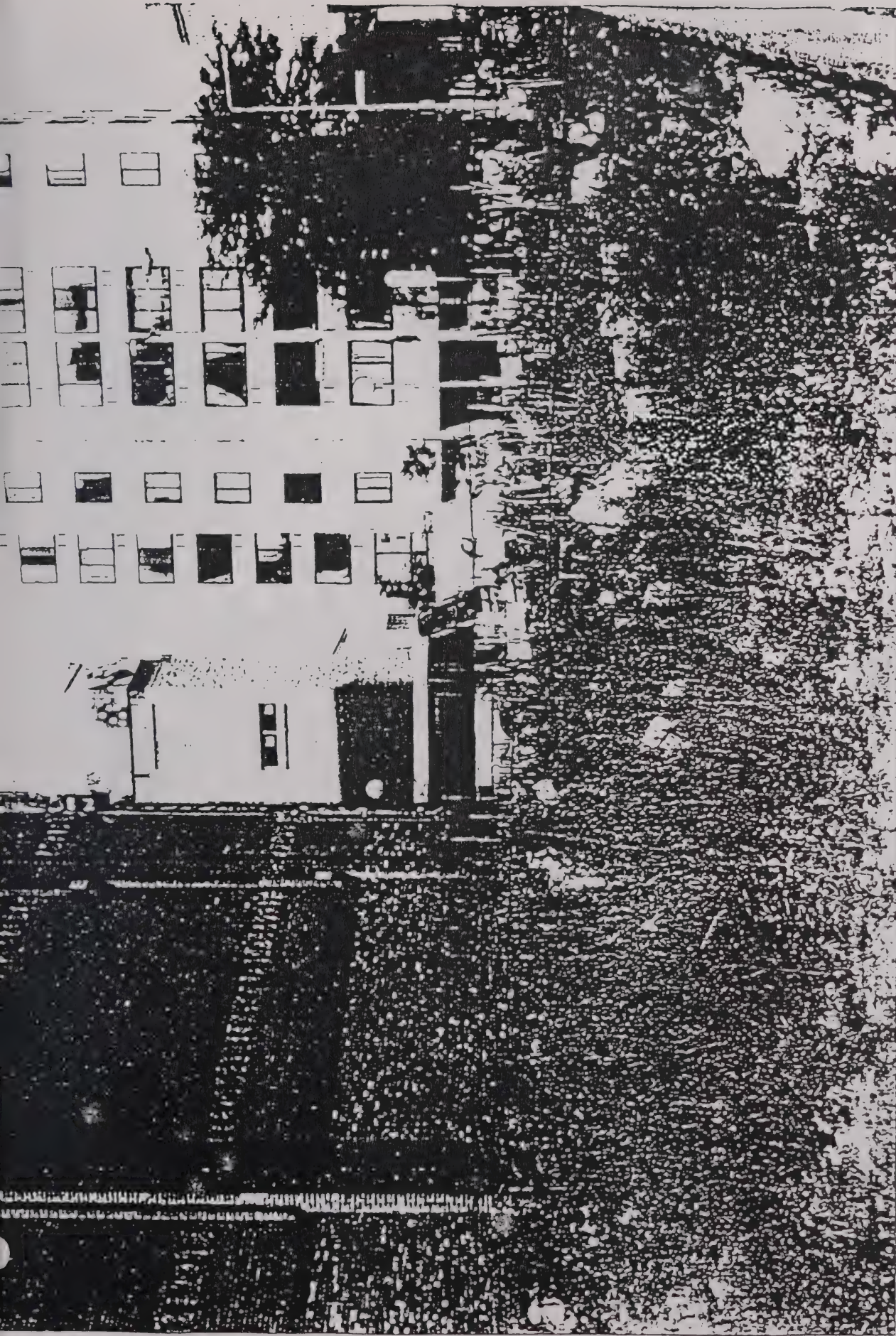


OAK TERRACE PROJECT
(BRA Parcel B)



SITE PHOTO

VIEW OF WASHINGTON STREET
ABANDONED BUILDING TO BE DEMOLISHED



SITE PHOTO

VIEW FROM OAK STREET IN THE COMMUNITY GARDEN
DIRECTLY ACROSS FROM THE QUINCY ELEMENTARY SCHOOL
AND QUINCY TOWERS ON WASHINGTON STREET



SITE PHOTO

VIEW FROM PINE STREET/PARCEL DIVISION LINE
(SITE ON LEFT)

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